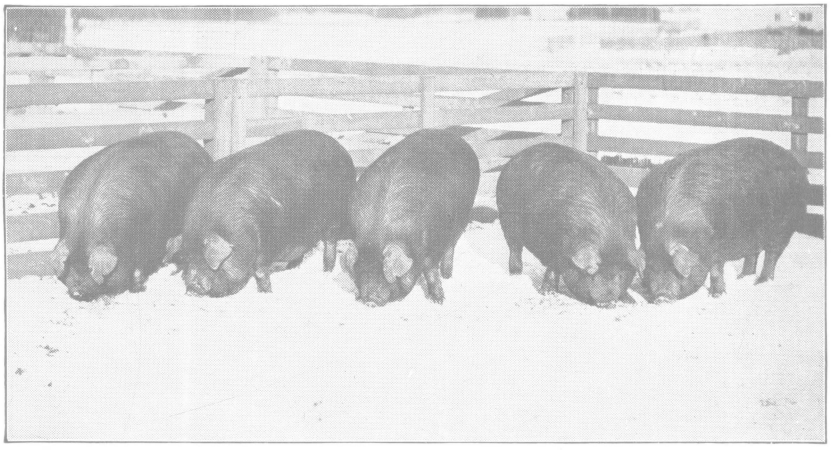
PROPORTIONS OF SUPPLEMENTS TO CORN FOR FATTENING SWINE

OHIO

Agricultural Experiment Station

WOOSTER, OHIO, U. S. A., SEPTEMBER, 1917

BULLETIN 316



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[1]In cooperation with the College of Agriculture, Ohio State University, Columbus.
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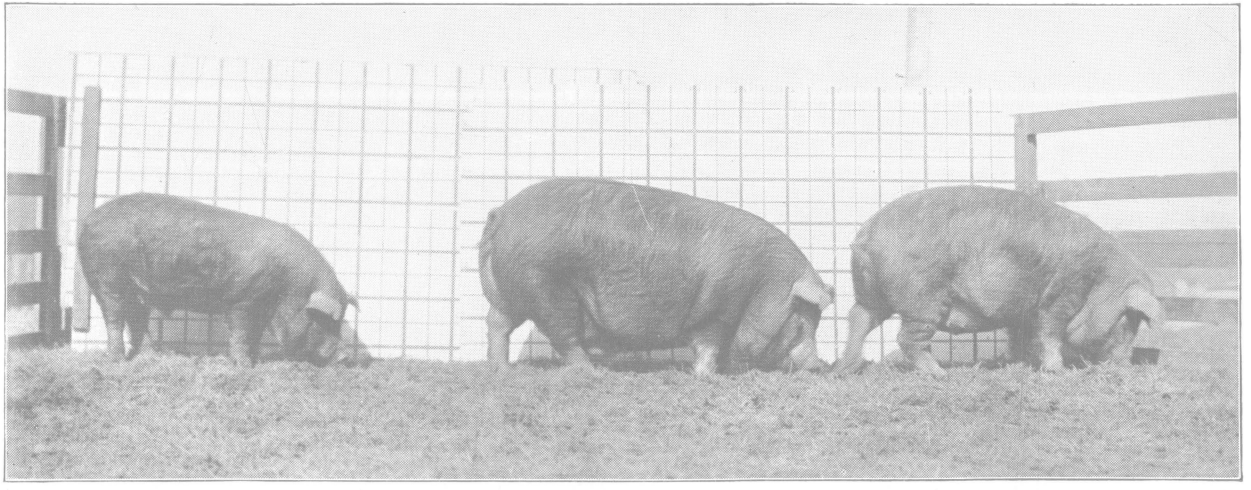

Pigs in Experiment IX

Pig at left fed corn alone; one in center fed one part of corn to five parts of skimmilk; and one at right fed nine parts of corn to one of tankage

BULLETIN

OF THE

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NUMBER 316 SEPTEMBER, 1917

PROPORTIONS OF SUPPLEMENTS TO CORN FOR FATTENING SWINE

W. L. ROBISON[1]

In sections where it is grown to any large extent, corn is the basis for economical rations in the growing and fattening of hogs. The extent of the swine industry in the cornbelt is evidence of this. Seven states of the Middle West produce almost 50 percent of the hogs raised in the United States. Corn has advanced in price until it can seldom be expected to give profitable returns if used as the sole feed for fattening hogs. It is the most palatable grain fed to hogs; is highly digestible; contains a small amount of crude fiber; is extremely rich in carbohydrates, chiefly starch; and contains a fair amount of oil, all of which make it a highly efficient feed for the production of heat, energy and fat.

For growing animals corn is deficient in protein and mineral matter. Investigators and practical feeders have found corn alone to have its limitations and to be a decidedly inefficient feed for the young hog even for fattening. Recent experimental evidence indicates that a large share of the low protein content of corn is of such a nature as to be of little or no value in aiding either tissue growth or repair and offers an explanation of the fact that the use of a protein-rich feed in connection with corn has been found highly beneficial. Since several feeds contain an excess of the nutrients in which corn is deficient, it is not difficult to supply a ration which will contain all the necessary nutrients. The correct proportions, however, in which to use these supplemental feeds have not been absolutely determined. There is little doubt that many are using such feeds in a way that does not permit them to do the most possible good.

[1]R E Caldwell was in charge of the swine investigations from June, 1909, to September, 1910, and G R Eastwood from September, 1910, to September, 1915. Experiments carried on within these dates were planned by and were conducted under the supervision of the one in charge at the time.

The objects of the experiments reported herein were to determine the relative efficiency of various proportions of corn and the more common supplements, and to compare different methods of proportioning these supplements.

GENERAL PLAN OF EXPERIMENTS

Pigs used.—Unless otherwise noted the pigs used were pure-bred Duroc-Jerseys from closely related dams. In selecting pigs for the various lots of each experiment, special care was taken to make the lots as nearly uniform as possible with regard to breeding, sex, age, weight, thrift and previous treatment.

Quarters.—All lots in an experiment had similar quarters, that, with the exception of the first three experiments reported, consisted of 10 by 12 foot pens in a central house built especially for housing hogs to be fed experimentally. The floor is of concrete, but a wooden overlay was provided for the pigs to sleep on during cold weather. A small amount of straw was used for bedding. The quarters were cleaned daily. The troughs are of wood and so constructed as to allow all the feed to be put in before giving the pigs access to it.

Weighing.—Individual weights of the pigs were taken just after noon at the beginning of the experiments and once each week at the same hour throughout the experiments. Care was taken to have the conditions at weighing time as nearly normal as possible; on weight-taking days water was withheld from 10 a. m. until after weighing. All experiments began with the evening feed on the first day and closed with the morning feed on the last day of the experiment. If for any reason it became necessary to remove a pig during the progress of a test, a record was made of its weight and date of removal.

Feeding.—With the exception that those receiving large quantities of skimmilk were given a part of the milk at noon, the pigs were fed twice daily at regular hours. Unless otherwise mentioned, the amount fed was determined by what the pigs would clean up readily without waste. The feeds were mixed dry. All proportions were determined by weight. Each daily feed was weighed out into morning and evening portions and, just before feeding, was mixed with sufficient water to form a thick slop. In cold weather warm water was used. An ample supply of water was furnished. Salt was also supplied either in the feed or in containers to which the pigs had access at all times. When other minerals were supplied, mention is made of it in the report of the experiment.

Feeds used.—The corn used was coarsely ground and of good quality. The tankage used was sold under guarantees to contain not less than 60 percent of protein; 6 percent of fat, 6 percent of phosphates and not more than 3 percent of crude fiber. The soybeans were grown on the Station farm, were of good quality and were ground before being fed. The skimmilk was furnished by the Dairy Department and was fed while sweet or only slightly sour. The linseed meal was the old process, finely ground oilmeal, guaranteed to contain 30 percent of crude protein.

The composition of the feeds was determined by the Departments of Chemistry and Dairying with results as shown in Table I.

TABLE I.—PERCENTAGE COMPOSITION OF FEEDS

	Water	Ash	Crude protein (N x 6.25)	Carbohydrates		Fat (ether extract)
				Fiber	N-free extract	
Ground corn (Experiment V)	12.68	1.39	9.23	1.64	71.65	3.41
Ground corn (Experiment VIII)	16.12	1.38	8.35	3.12	68.18	2.85
Ground corn (Experiment IX)	15.34	1.29	8.45	2.18	69.11	3.63
Tankage (Experiment V)	7.53	13.49	60.07	4.33	1.88	12.7
Tankage (Experiments VIII and IX)	9.54	16.18	61.05	2.22	3.54	7.47
Soybeans (Experiment V)	10.45	5.28	38.11	3.79	25.81	16.56
Linseed oilmeal (Experiment V)	10.88	5.31	33.57	8.10	36.24	5.9
Skimmilk (Experiments VIII and IX)	90.48	.751	3.325	.....	5.32	.02

Prices of feeds.—For the purpose of furnishing a further basis of comparison, the following constant prices of feeds were used in calculating the cost of gains for all the experiments reported:

Ground corn ..... $25 per ton
Tankage ..... 50 " "
Soybeans ..... 36 " "
Linseed oilmeal ..... 36 " "
Skimmilk ..... 4 " "

METHODS OF PROPORTIONING TANKAGE AS A SUPPLEMENT TO CORN

EXPERIMENT I

In this experiment tankage was used as a supplement to corn, (1) in a definite proportion to the corn, (2) in a constant daily amount and (3) in a decreasing percentage of the ration. Three lots of five pigs each, which averaged 45 pounds at the beginning of the test, were placed in dry lots and fed as follows:

Lot I: Corn, 481 parts; tankage, 59 parts
Lot II: Corn; tankage, 0.36875 pound daily per pig
Lot III: Corn; tankage, 20 percent to 5 percent of the ration

At the end of 16 weeks the three lots were to have received equal weights of corn and tankage, viz, 1,683.5 pounds of corn and

206.5 pounds of tankage. This accounts for the unusual proportions of corn and tankage fed Lot I and the daily allowance of tankage given Lot II. The amount of tankage in the ration fed the pigs of Lot III was decreased 1 percent each week, beginning with 20 percent the first week and closing with 5 percent the sixteenth week. All three lots were given the same total amounts of feed each day. (Lot I refused 1 pound of feed August 25). The removal of a pig from each lot on September 19 caused a slight difference in the total amounts of corn and of tankage consumed by the three lots.

The pigs were placed on the different rations soon after weaning and continued from August 1 to November 21, 1911 (16 weeks) with results as given in Table II.

TABLE II.—EXPERIMENT I: METHODS OF PROPORTIONING TANKAGE

	Lot I Corn, 481; tankage, 59	Lot II Corn; tankage, 0.36875 pound daily	Lot III Corn; tankage, 20 to 5 percent of total ration
Average initial weight.....pounds..	45.3	45.0	45.2
Average final weight.....do...	152.5	155.125	156.25
Total gain*.....do...	463.0	456.5	463.0
Average daily gain per pig.....do...	.932	.9185	.932
Feed consumed:			
Corn.....do...	1442.41	1437.08	1437.6
Tankage.....do....	176.94	183.27	182.75
Total.....do....	1619.35	1620.35	1620.35
Average daily feed per pig:			
Corn.....do....	2.902	2.892	2.892
Tankage.....do...	.356	.368	.367
Total.....do....	3.258	3.260	3.259
Feed consumed per pound gain.....do...	3.498	3.550	3.500
Cost of feed per pound gain†.....cents .	4.849	4.939	4.868

*One pig was taken out of each lot on September 19: Lot I, weight 79.5 lb.; Lot II, weight 57 lb.; and Lot III, weight 64 lb.

†Scale of prices given on page 5.

Lots I and III gained at the same rate. The feed requirement per unit of gain for those two lots was also nearly the same. The pigs of Lot II gained at a slightly lower rate and required a greater amount of feed to produce a pound of gain than did the pigs of Lots I and III.

A study of the results secured during each 4-week period of the test shows that for the first 12 weeks, Lot III gained at the average rate of 0.826 pound daily and consumed 3.378 pounds of feed per pound of gain produced, gaining more rapidly and requiring less feed per unit of gain for each of the three periods than Lot I, which for the same time gained at the average rate of 0.787 pound daily and consumed 3.542 pounds of feed per pound of gain. During the last 4 weeks of the test the results were reversed, Lot I making an average daily gain of 1.429 and Lot III of 1.295 pounds, while the

feed consumed per pound of gain was 3.413 and 3.765 pounds, respectively. During the first and third periods Lot II gained less than Lot I or Lot III; during the second period Lot II made a greater gain than Lot I but less than Lot III. During the fourth period Lot II gained more than Lot III and less than Lot I. The feed required per unit of gain decreased in all cases with an increase in the rate of gain.

TABLE III.—EXPERIMENT I: METHODS OF PROPORTIONING TANKAGE
(Feeding period divided into four parts of 4 weeks each)

	Lot I Corn, 481; tankage, 59	Lot II Corn; tankage, 0.36875 pound daily	Lot III Corn; tankage, 20 to 5 percent of total ration
FIRST PERIOD—			
Average daily gain.....pounds..	0.529	0.521	0.543
Average daily feed per pig:			
Corn.....do....	1.642	1.481	1.511
Tankage.....do....	.201	.369	.339 (20-17 %)
Total.....do....	1.843	1.85	1.85
Feed consumed per pound gain:			
Corn.....do....	3.106	2.841	2.784
Tankage.....do....	.381	.707	.624
Total.....do....	3.487	3.548	3.408
Cost of feed per pound gain.....cents..	4.83	5.32	5.04
SECOND PERIOD—			
Average daily gain.....pounds..	.797	.857	.876
Average daily feed per pig:			
Corn.....do....	2.554	2.499	2.453
Tankage.....do....	.313	.369	.415 (16-13 %)
Total.....do....	2.867	2.868	2.868
Feed consumed per pound gain:			
Corn.....do....	3.205	2.915	2.800
Tankage.....do....	.393	.430	.473
Total.....do....	3.598	3.345	3.273
Cost of feed per pound gain.....cents..	4.99	4.72	4.68
THIRD PERIOD—			
Average daily gain.....pounds..	1.098	1.085	1.121
Average daily feed per pig:			
Corn.....do ...	3.452	3.506	3.471
Tankage.....do....	.423	.369	.404 (12-9 %)
Total.....do....	3.875	3.875	3.875
Feed consumed per pound gain:			
Corn.....do....	3.143	3.232	3.098
Tankage.....do....	.385	.340	.360
Total.....do....	3.528	3.572	3.458
Cost of feed per pound gain.....cents..	4.89	4.89	4.77
FOURTH PERIOD—			
Average daily gain.....pounds..	1.429	1.321	1.295
Average daily feed per pig:			
Corn.....do...	4.342	4.506	4.561
Tankage.....do....	.533	.369	.314 (8-5 %)
Total.....do....	4.875	4.875	4.875
Feed consumed per pound gain:			
Corn.....do....	3.040	3.410	3.523
Tankage.....do....	.373	.279	.242
Total.....do....	3.413	3.689	3.765
Cost of feed per pound gain.....cents..	4.73	4.96	5.01

EXPERIMENT II

In a second trial three lots of four pigs each, which averaged 57.5 pounds and which were similar in character to those used in

Experiment I, were given a full feed of the following rations in dry lot:

Lot I: Corn, 8 parts; tankage, 1 part
Lot II: Corn, plus ⅜ of a pound of tankage daily
Lot III: Corn, plus tankage, decreasing from 20 percent to 5 percent of the ration

The test lasted from August 31 to December 20, 1911 (16 weeks) with the results as given in Table IV.

TABLE IV.—EXPERIMENT II: METHODS OF PROPORTIONING TANKAGE

	Lot I Corn, 8; tankage, 1	Lot II Corn; tankage, ⅜ pound daily	Lot III Corn; tankage 20 to 5 percent
Average initial weight ..... pounds..	57.187	58.375	56.812
Final weight ..... do....	213.75	208.625	217.00
Total gain ..... do....	626.25	601.00	640.75
Average daily gain ..... do....	1.40	1.34	1.43
Feed consumed:			
Corn ..... do....	2052.44	2026.00	2042.578
Tankage ..... do....	256.56	168.00	256.922
Total ..... do....	2309.00	2194.00	2299.500
Average daily feed per pig:			
Corn ..... do....	4.581	4.520	4.559
Tankage ..... do....	.573	.375	.573
Total ..... do....	5.154	4.897	5.132
Feed consumed per pound gain ..... do...	3.687	3.650	3.589
Cost of feed per pound gain* ..... cents.	5.121	4.913	4.987

*Scale of prices given on page 5.

While the pigs in Lot II made slightly slower gains, they consumed less tankage than the other two lots. This resulted in a saving over Lots I and III of 21 and of 7 cents, respectively, for each 100 pounds of gain produced. Lot I, which received corn, 8 parts; tankage, 1 part; and Lot III, fed corn plus tankage in decreasing amounts from 20 to 5 percent of the ration, consumed the same amounts of tankage, gained at almost the same rate and differed less than 3 percent in the amount of feed required per unit of gain. It is interesting to note that because of the increased feed consumption, the weekly amount of tankage consumed by the pigs of Lot I constantly increased during the 16 weeks of the trial, while the weekly allowance of tankage for the pigs of Lot III increased up to the ninth week of the test, but after that time rapidly decreased until at the end of the test the weekly amount was less than one-half as much as that given Lot I. This is shown to some extent in Table V, as noted in the average daily amounts of tankage consumed.

In Table V the experiment has been summarized for four periods of 4 weeks each. For the first, second and fourth periods, Lot III made more rapid gains, required less feed per pound of gain,

and, at the prices used, made cheaper gains than Lot I. During the first and second periods, Lot III consumed more tankage per unit of gain than Lot I. For the third period, the amount of tankage consumed per pound of gain was the same for the two lots, while for the fourth period of the test, it was less for Lot III than for Lot I. During the first period, Lot II received a slightly larger amount of tankage than Lot I. After this time their allowance of tankage was less than that for either of the other two lots.

For the first three periods the lots which received the greater amounts of tankage gained at a higher rate and required less feed per unit of gain than those which received smaller amounts of tankage.

TABLE V.—EXPERIMENT II: METHODS OF PROPORTIONING TANKAGE
(Feeding period divided into four parts of 4 weeks each)

	Lot I Corn, 8; tankage, 1	Lot II Corn; tankage, ⅜ pound daily	Lot III Corn; tankage, 20 to 5 percent
FIRST PERIOD—			
Average daily gain.....pounds..	0.931	0.987	1.025
Average daily feed per pig:			
Corn.....do....	2.766	2.737	2.490
Tankage.....do....	.346	.375	.559 (20-17 %)
Total.....do....	3.112	3.112	3.049
Feed consumed per pound gain:			
Corn.....do....	2.971	2.774	2.430
Tankage.....do....	.371	.380	.546
Total.....do....	3.343	3.154	2.976
Cost of feed per pound gain*.....cents..	4.641	4.417	4.402
SECOND PERIOD—			
Average daily gain.....pounds..	1.375	1.326	1.429
Average daily feed per pig:			
Corn.....do....	4.055	4.094	3.925
Tankage.....do....	.507	.375	.660 (16-13 %)
Total.....do....	4.562	4.469	4.585
Feed consumed per pound gain:			
Corn.....do....	2.949	3.087	2.747
Tankage.....do....	.369	.283	.462
Total.....do....	3.318	3.370	3.209
Cost of feed per pound gain.....cents..	4.609	4.566	4.589
THIRD PERIOD—			
Average daily gain.....pounds..	1.679	1.411	1.567
Average daily feed per pig:			
Corn.....do....	5.397	5.116	5.405
Tankage.....do....	.679	.375	.631 (12-9 %)
Total.....do....	6.072	5.491	6.036
Feed consumed per pound gain:			
Corn.....do....	3.215	3.627	3.449
Tankage.....do....	.402	.266	.402
Total.....do....	3.617	3.892	3.852
Cost of feed per pound gain.....cents..	5.024	5.199	5.316
FOURTH PERIOD—			
Average daily gain.....pounds..	1.607	1.643	1.701
Average daily feed per pig:			
Corn.....do....	6.107	6.143	6.418
Tankage.....do....	.763	.375	.444 (8-5 %)
Total.....do....	6.870	6.518	6.862
Feed consumed per pound gain:			
Corn.....do....	3.800	3.739	3.773
Tankage.....do....	.475	.228	.261
Total.....do....	4.275	3.967	4 034
Cost of feed per pound gain.....cents..	5.937	5.244	5.369

*Scale of prices given on page 5.

EXPERIMENT III

In the third experiment two lots of four pigs each were used. These were larger at the beginning of the trial than the pigs in Experiments I and II, averaging almost 75 pounds at the time they were placed on feed. After weaning they had been allowed free range of a bluegrass pasture, and had been fed a ration of corn, 8 parts, and tankage, 1 part. The experiment began October 17, 1911, and ended February 6, 1912, a period of 16 weeks. Lot I was fed corn, 8 parts, and tankage, 1 part. The tankage for Lot II decreased from 20 percent to 5 percent of the ration fed. The results of the experiment are shown in Table VI.

TABLE VI.—EXPERIMENT III: METHODS OF PROPORTIONING TANKAGE

	Lot I Corn, 8; tankage, 1	Lot II Corn; tankage, decreasing from 20 to 5 percent
Average initial weight.....pounds..	75.375	74.5
Average final weight.....do...	225.0	207.25
Total gain.....do....	598.5	531.0
Average daily gain.....do....	1.335	1.19
Feed consumed:		
Corn.....do....	2093.76	1899.48
Supplement.....do....	261.72	235.768
Total.....do....	2355.48	2135.248
Average daily feed per pig:		
Corn.....do....	4.674	4.24
Supplement.....do....	.584	.526
Total.....do....	5.258	4.766
Feed consumed per pound gain.....do....	3.936	4.021
Cost of feed per pound gain*.....cents..	5.466	5.581

*Scale of prices given on page 5.

It will be noted that in this case the use of corn and tankage in constant proportion produced not only larger but also more economical gains than resulted from the use of tankage in decreasing percentages. This is just the opposite of the results obtained with the younger pigs in Experiment II. The rate of gain was 0.15 pound more per day for the pigs fed a definite proportion of tankage, and the saving in feed was 8.5 pounds per 100 pounds gain.

Table VII gives a summary of the test in periods of 4 weeks each. Knowing the results of the first and second experiments, one would have expected Lot II, receiving the narrower ration for the first period, to have made the more rapid gains of the two lots during that time. Such, however, was not the case. For the first 4 weeks the average daily feed consumed per pig, the rate of gain and the feed required per unit of gain were in favor of Lot I. This was also true of the second and third periods, but the differences in the rate of gain and in the feed requirement per unit of gain decreased

for each period. For the fourth period the difference in the rate of gain was still smaller, but remained in favor of Lot I. For this period, however, Lot II consumed fewer pounds of feed per pound of gain produced than Lot I.

TABLE VII.—EXPERIMENT III: METHODS OF PROPORTIONING TANKAGE

(Feeding period divided into four parts of 4 weeks each)

	Corn, 8; tankage, 1	Corn; tankage, 20 to 5 percent of ration
FIRST PERIOD—		
Average daily gain.....pounds..	0.911	0.683
Average daily feed per pig:		
Corn.....do....	3.075	2.472
Tankage.....do....	.384	.561 (20-17 %)
Total.....do....	3.460	3.033
Feed per pound gain:		
Corn.....do....	3.377	3.620
Tankage.....do....	.422	.821
Total.....do....	3.799	4.441
Cost of feed per pound gain*.....cents..	5.276	6.577
SECOND PERIOD—		
Average daily gain.....pounds..	1.237	1.045
Average daily feed per pig:		
Corn.....do....	3.956	3.275
Tankage.....do....	.495	.551 (16-13 %)
Total.....do....	4.451	3.826
Feed per pound gain:		
Corn.....do....	3.199	3.135
Tankage.....do....	.400	.527
Total.....do....	3.599	3.662
Cost of feed per pound gain.....cents..	4.999	5.236
THIRD PERIOD—		
Average daily gain.....pounds..	1.469	1.321
Average daily feed per pig:		
Corn.....do....	5.179	4.761
Tankage.....do....	.647	.551 (12-9 %)
Total.....do....	5.826	5.312
Feed per pound gain:		
Corn.....do....	3.526	3.603
Tankage.....do....	.441	.417
Total.....do....	3.967	4.020
Cost of feed per pound gain.....cents..	5.509	5.547
FOURTH PERIOD—		
Average daily gain.....pounds..	1.728	1.692
Average daily feed per pig:		
Corn.....do....	6.484	6.451
Tankage.....do....	.811	.442 (8-5 %)
Total.....do....	7.295	6.893
Feed per pound gain:		
Corn.....do....	3.753	3.813
Tankage.....do....	.469	.261
Total.....do....	4.222	4.074
Cost of feed per pound gain.....cents..	5.864	5.418

*Scale of prices given on page 5.

METHODS OF PROPORTIONING DIFFERENT AMOUNTS OF TANKAGE

EXPERIMENT IV

This experiment was conducted for the purpose of comparing various proportions of corn and tankage when the supplement was fed in a constant proportion and when fed in decreasing percentages as the feeding period advanced. The intention was to feed 50 per-

cent as much tankage in the medium rations and 25 percent as much in the wide rations as was fed in the narrow rations, and also to feed the same (or nearly the same) total amounts of tankage in the two narrow, in the two medium, and in the two wide rations, regardless of whether it was fed in a constant proportion or in a decreasing percentage. While it was almost impossible to feed the exact amounts as planned, the actual quantities fed approximated the amounts that it was planned to feed. Thirty pigs which averaged 47 pounds at the beginning of the test were divided into six uniform lots and fed as shown in Table VIII. The test lasted from January 8 to May 28, 1913, a period of 20 weeks.

TABLE VIII.—EXPERIMENT IV: METHODS OF PROPORTIONING DIFFERENT AMOUNTS OF TANKAGE

	Lot 1 Corn, 83.6; tankage, 16.94 per-cent	Lot II Corn, 91.17 percent tankage, 8.83 per-cent	Lot III Corn, 94.97 per-cent; tankage, 5.03 per-cent	Lot IV Corn; tankage, 32.7 to 13.8 per-cent of ration	Lot V Corn; tangage, 16.4 to 6 percent of ration	Lot VI Corn; tankage, 8.2 to 3 peroent of ration
Average initial weight ..... pounds..	47.2	47.3	46.6	46.9	46.9	47.8
Average final weight.....do....	256.125	253.875	222.0	230.25	236.25	248.125
Total gain*.....do....	915.0	862.0	757.0	798.0	827.0	832.0
Average daily gain.....do....	1.39	1.34	1.15	1.27	1.28	1.29
Feed consumed:						
Corn.....do....	3047.0	3123.50	2933.25	2636.30	2996.9	3209.45
Supplement.....do....	621.6	302.68	155.40	602.84	311.5	155.75
Total .....do....	3668.6	3426.18	3088.65	3239.14	3308.4	3365.20
Average daily feed per pig:						
Corn.....do....	4.63	4.85	4.458	4.211	4.653	4.983
Supplement.....do....	.945	.47	.236	.963	.484	.242
Total .....do....	5.57	5.32	4.694	5.174	5.137	5.225
Feed consumed per pound gain:						
Corn.....do....	3.33	3.624	3.875	3.304	3.624	3.858
Supplement.....do....	.679	.351	.205	.755	.377	.187
Total .....do....	4.009	3.975	4.080	4.059	4.001	4.045
Cost of feed per pound gain†.....cents..	5.86	5.407	5.357	6.018	5.471	5.290

*March 15, pig taken out of Lot IV, weight 104.5 lb.; April 2, pig taken out of Lot II, weight 88 lb.; Lot V, weight 116 lb.; Lot VI, weight 78.5 lb. April 16, pig taken out of Lot I, weight 126.5 lb.; Lot III, weight 102 lb.

†Scale of prices given on page 5.

The average daily gains for the six lots ranged from 1.15 pounds for the pigs that were fed a ration containing 5.03 percent of tankage to 1.39 pounds for those fed a ration containing 16.94 percent of tankage. The rate of gain was higher for Lot I than for Lot IV, and for Lot II than for Lot V. Lot VI, however, gained more rapidly than Lot III.

Lot II, fed 10.3 parts of corn to one part of tankage, required less feed per unit of gain than any of the other lots. Lot V, which received 9.6 parts of corn to 1 part of tankage, but was fed the tankage in decreasing amounts from 16.4 to 6 percent of the ration, made the second best gains per unit of total feed consumed. With the prices given, Lots III and VI made slightly cheaper gains than

the other lots. The smaller amounts of tankage consumed by Lot III proved to be sufficient to more than offset their slower rate of gain and higher feed requirement per unit of gain. The additional labor, risk, interest and danger of unfavorable market fluctuations in keeping the hogs a greater length of time would partly counterbalance the lower cost of production.

When both the cost of gains and feed required per unit of gain are considered, Lots I and IV made the poorest showing of all the lots in the test. Lot III required but 7.1 pounds more feed per 100 pounds gain than Lot I, and Lot VI required 1.4 pounds less feed per 100 pounds gain than Lot IV. Lots III and VI received only one-fourth as much tankage as Lots I and IV, making their rations much cheaper.

Of the two rations containing the smallest proportions of tankage, it proved to be more economical to feed a relatively larger amount of tankage at first and gradually to decrease the percentage as the pigs became older than to feed a definite percentage of tankage throughout the experiment. The medium and narrow rations gave results slightly in favor of feeding tankage in constant proportions.

In Table IX the total feeding period is divided into five periods of 4 weeks each. This allows an opportunity for a study of the results obtained at different stages of the fattening period. While the pigs were young, the rate and economy of gains were usually in favor of the lots which received the rations containing the larger percentages of tankage. It will also be noted that for pigs of the same age a decrease in the feed requirement per unit of gain was, as a rule, directly associated with an increase in the rate of gain. An average of all the lots shows an increase for each successive period in the rate of gain and in the feed requirement per unit of gain in live weight. The average gain was 0.779, 1.076, 1.349, 1.572 and 1.704 pounds daily per pig. The average amount of feed required to produce a pound of gain during each successive period was 3.485, 3.924, 4.004, 4.215 and 4.268 pounds, respectively.

TABLE IX.—EXPERIMENT IV: METHODS OF PROPORTIONING DIFFERENT AMOUNTS OF TANKAGE

(Feeding period divided into five parts of 4 weeks each)

	Lot I Corn, 83.06 %; tankage, 16.94 %	Lot II Corn, 91.17 % tankage, 8.83 %	Lot III Corn, 94.97 %; tankage, 5.03 %	Lot IV Corn; tankage, 32.7 to 13.8 % of ration	Lot V Corn; tankage, 16.4 to 6 % of ration	Lot VI Corn; tankage 8.2 to 3 % of ration
FIRST PERIOD—						
Tankage in the ration.....percent..	17.9	9.8	4.8	26.4	14.4	7.1
Average daily gain.....pounds..	.83	.73	.67	.95	.77	.72
Average daily feed per pig.....do....	2.853	2.61	3.647	2.884	2.640	2.657
Feed per pound gain:						
Corn.....do....	2.815	3.233	3.753	2.227	2.943	3.420
Tankage.....do....	.613	.350	.190	.797	.495	.263
Total.....do....	3.428	3.583	3.943	3.024	3.438	3.684
Cost of feed per pound gain*.....cents..	5.052	4.916	5.166	4.776	4.916	4.934
SECOND PERIOD—						
Tankage in the ration.....percent.	16.1	8.8	4.7	23.4	11.5	5.9
Average daily gain.....pounds..	1.150	1.093	.996	1.093	1.080	1.046
Average daily feed per pig.....do....	4.604	4.188	3.965	4.189	4.269	4.120
Feed per pound gain:						
Corn.....do....	3.360	3.493	3.794	2.936	3.503	3.703
Tankage.....do....	.643	.339	.186	.897	.454	.234
Total.....do....	4.004	3.832	3.980	3.833	3.958	3.937
Cost of feed per pound gain.....cents.	5.809	5.213	5.206	5.259	5.515	5.214
THIRD PERIOD—						
Tankage in the ration.....percent.	16.3	8.9	5.2	19.9	10.3	5.1
Average daily gain.....pounds..	1.639	1.343	1.043	1.508	1.343	1.246
Average daily feed per pig.....do...	5.966	5.464	4.662	5.559	5.398	5.415
Feed per pound gain:						
Corn.....do....	3.048	3.707	4.238	2.951	3.606	4.122
Tankage.....do...	.592	.361	.233	.735	.413	.223
Total.....do....	3.640	4.069	4.471	3.686	4.020	4.344
Cost of feed per pound gain.....cents..	5.289	5.537	5.879	5.526	5.541	5.709
FOURTH PERIOD—						
Tankage in the ration.....percent..	16.6	8.5	5.2	15.3	7.9	3.7
Average daily gain.....pounds..	1.508	1.736	1.480	1.428	1.670	1.826
Average daily feed per pig.....do....	7.192	7.087	5.723	6.913	6.679	7.040
Feed per pound gain:.						
Corn.....do...	3.976	3.735	3.665	4.097	3.683	3.710
Tankage.....do....	.793	.346	.202	.742	.317	.145
Total.....do...	4.769	4.081	3.867	4.839	4.000	3.855
Cost of feed per pound gain.....cents.	6.953	5.533	5.086	6.976	5.397	5.001
FIFTH PERIOD—						
Tankage in the ration.....percent..	18.1	8.7	5.1	13.2	6.3	3.0
Average daily gain.....pounds..	1.946	2.004	1.705	1.433	1.728	1.835
Average daily feed per pig.....do....	7.885	8.177	7.045	7.112	7.477	7.766
Feed per pound gain:						
Corn.....do....	3.316	3.723	3.921	4.307	4.056	4.105
Tankage.....do....	.735	.357	.210	.656	.272	.128
Total.....do....	4.051	4.080	4.131	4.963	4.328	4.233
Cost of feed per pound gain.....cents..	5.980	5.545	5.425	7.023	5.747	5.450

*Scale of prices given on page 5.

COMPARISONS OF VARIOUS PROPORTIONS OF SUPPLEMENTS

EXPERIMENT V

In an experiment conducted to compare tankage, soybeans and linseed oilmeal as supplements to corn, and to compare rations containing various proportions of corn and soybeans and of corn and tankage, eight uniform lots of five pigs each, approximately 6 months of age when the experiment began, were fed from November 17, 1909, to February 9, 1910 (84 days) on the rations given below:

Lot I: Corn alone
Lot II: Corn, 2 parts; soybeans, 1 part
Lot III: Corn, 5 parts; soybeans, 1 part
Lot IV: Corn, 11 parts; soybeans, 1 part
Lot V: Corn, 4 parts; tankage, 1 part
Lot VI: Corn, 9 parts; tankage, 1 part
Lot VII: Corn, 19 parts; tankage, 1 part
Lot VIII: Corn, 5 parts; linseed oilmeal, 1 part

The pigs used were thrifty, well-grown, purebred Durocs which averaged 144.9 pounds at the beginning of the experiment. Before weaning these pigs had received corn, middlings, tankage and skim-milk. During the summer they were allowed to run on bluegrass and were given a ration of corn, 8 parts; tankage, 1 part.

The composition of the feeds used was determined by the Department of Chemistry with the results as shown in Table I, page 5.

Table X shows the results secured from the various rations.

Owing to the fact that the pigs were well grown at the beginning of the test, better results than usual were obtained from the use of corn alone. Other trials conducted with younger pigs show a greater difference in the rate and economy of gains from the use of rations of corn alone and of those containing some supplemental protein feed. The pigs fed corn alone made the smallest gain of all the lots. They ate less corn than the pigs fed a ration containing 10 percent of tankage, the addition of which resulted in a 36.2-percent increase in rate of gain. The pigs fed corn, 9; tankage, 1, gained more rapidly and required less feed per unit of gain than those fed any of the other rations.

In comparison with the rations of corn alone, an increase in the proportion of supplement fed increased the amount of supplemental feed required to replace a unit of corn. With the rations containing 33⅓, 16⅔ and 8⅓ percent of ground soybeans, 78.035 pounds, 73.684 pounds and 49.275 pounds, respectively, were needed to replace 100 pounds of the corn. Of the rations containing tankage, 100 pounds of corn was replaced by 65.041 pounds, 46.512 pounds and 31.746 pounds of the tankage when the latter constituted 20, 10 and 5 percent of the rations, respectively. When one part of linseed oilmeal to five parts of corn was fed, 66.019 pounds of the linseed oilmeal replaced 100 pounds of corn. Because of the greater amount of nonnitrogenous nutrients they contain, when fed on a basis of approximately equal amounts of protein, soybeans and linseed oilmeal have a higher feeding value per unit of protein than tankage.

TABLE X.—EXPERIMENT V: VARIOUS PROPORTIONS OF SUPPLEMENTS

	Lot I Corn alone	Lot II Corn, 2; soybeans, 1	Lot III Corn, 5; soybeans, 1	Lot IV Corn, 11; soybeans, 1	Lot V Corn, 4; tankage, 1	Lot VI Corn, 9; tankage, 1	Lot VII Corn, 19; tankage. 1	Lot VIII Corn, 5; linseed oil-meal, 1
Average initial weight..... pounds..	140.9	145.2	146.1	145.6	145.3	144.4	145.8	145.7
Average final weight..... ....do...	264.3	291.8	281.8	284.7	303.0	312.5	303.2	*307.5
Total gain.....do...	617.0	733.0	678.5	695.5	788.5	840.5	787.0	762.0
Average daily gain.....do....	1.47	1.75	1.62	1.66	1.88	2.0	1.87	1.85
Feed consumed:								
Corn..... .....do....	2731.0	1982.0	2361.0	2600.5	2525.0	3000.5	2990.5	2593.5
Supplement.....do....	.....	991.0	472.0	236.5	631.25	333.5	157.5	518.5
Total.....do...	2731.0	2973.0	2833.0	2837.0	3156.25	3334.0	3148.0	3112.0
Average daily feed per pig:								
Corn.....do....	6.5	4.72	5.62	6.19	6.01	7.14	7.12	6.29
Supplement.....do....	.....	2.36	1.12	.56	1.50	.79	.37	1.26
Total.....do....	6.5	7.08	6.74	6.75	7.51	7.93	7.49	7.55
Feed consumed per pound gain:								
Corn.....do....	4.43	2.70	3.48	3.74	3.20	3.57	3.80	3.40
Supplement.....do...	.....	1.35	.70	.34	.80	.40	.20	.68
Total.....do....	4.43	4.05	4.18	4.08	4.00	3.97	4.00	4.08
Cost of feed per pound gain†. .....cents..	5.53	5.81	5.6	5 29	6.00	5.45	5.25	5.48

*One hog taken out of lot February 1, weight 260.5 lb.
†Scale of prices given on page 5.

The rations of corn and soybeans were less palatable than those that contained tankage or linseed oilmeal as supplements. The pigs that received corn and soybeans required, on the average, slightly more feed per unit of gain than those that received corn and tankage. Rations of corn and linseed oilmeal and of corn and soybeans were about of equal efficiency so far as feed consumed per unit of gain was concerned, but the pigs fed linseed oilmeal consumed more feed per day and made more rapid gains than those fed soybeans.

The three rations of corn and tankage produced more rapid gains and showed a lower feed requirement per pound of gain than any of the other rations. The pigs fed corn, 9 parts, and tankage, 1 part, consumed less feed per unit of gain than those fed corn, 4 parts, and tankage, 1 part; or those fed 19 parts of corn to 1 part of tankage.

TABLE XI.—EXPERIMENT V: COST OF FEED PER 100 POUNDS GAIN

Price of corn per bushel	Lot I Corn alone	Lot II Corn, 2; soybeans, 1	Lot III Corn, 5; soybeans, 1	Lot IV Corn, 11; soybeans, 1	Lot V Corn, 4; tankage, 1	Lot VI Corn, 9; tankage, 1	Lot VII Corn, 19; tankage, 1	Lot VIII Corn, 5; linseed oilmeal, 1
$0.56	$ 4.43	$ 5.54	$ 4.95	$ 4.45	$ 5.60	$ 4.77	$ 4.40	$ 4.83
.70	5.54	6.21	5.82	5.39	6.40	5.66	5.35	5.68
.84	6.65	6.89	6.69	6.32	7.20	6.56	6.30	6.53
.98	7.75	7.56	7.56	7.26	8.00	7.45	7.25	7.38
1.12	8.86	8.24	8.43	8.19	8.80	8.34	8.20	8.23
1.26	9.97	8.91	9.30	9.13	9.60	9.23	9.15	9.08
1.40	11.08	9.59	10.17	10.06	10.40	10.13	10.10	9.93
1.54	12.18	10.26	11.04	11.00	11.20	11.02	11.05	10.78
1.68	13.29	10.94	11.91	11.93	12.00	11.91	12.00	11.63

Table XI shows the cost of feed per 100 pounds gain for the various lots with the prices of ground soybeans, linseed oilmeal and tankage at $42, $42 and $60 per ton, respectively, and the price of corn ranging from 56 cents to $1.68 per bushel. Since the hogs used in the experiment averaged 144.9 pounds at the beginning of the test, those fed corn alone made, in comparison with those fed some supplemental feed in addition to corn, a much better showing than has been secured from similar comparisons with younger pigs. With corn valued at the lower prices the use of a ration of corn alone resulted in cheaper gains than did some of the rations containing the supplemental feeds, especially those carrying the larger proportions of such feeds. It should be remembered that supplements are likely to be cheap when corn is cheap and that it will often pay to use at least a small amount of a feed of this kind even with low-priced corn and with hogs of the age used in this experiment.

TABLE XII.—EXPERIMENT V: SHOWING DIFFERENCE PER LOT BETWEEN THE COST OF FEED AND THE SELLING PRICE OF GAINS PRODUCED*

Hogs per cwt.	Ration	Value of gain minus cost of feed											
		Corn 42 cents per bushel			Corn 56 cents per bushel			Corn 70 cents per bushel			Corn 84 cents per bushel		
		Tankage per ton			Tankage per ton			Tankage per ton			Tankage per ton		
		$42	$48	$54	$42	$48	$54	$42	$48	$54	$42	$48	$54
$6	Corn alone	$16.520	$16.520	$16.520	$ 9.687	$ 9.687	$ 9.687	$ 2.854	$ 2.854	$ 2.854	$—3.980	$—3.980	$—3.980
	Corn, 4; tankage, 1	15.139	13.247	11.354	8.831	6.939	5.046	2.523	.631	—1.262	—3.785	—5.677	—7.570
	Corn, 9; tankage, 1	20.865	19.857	18.848	13.364	12.355	11.347	5.862	4.854	3.845	—1.639	—2.648	—3.656
	Corn, 19; tankage, 1	21.485	21.013	20.541	14.009	13.536	13.064	6.532	6.060	5.588	— .944	—1.417	—1 889
$7	Corn alone	22.690	22.690	22.690	15.857	15.857	15.857	9.024	9.024	9.024	2.190	2.190	2.190
	Corn, 4; tankage, 1	23.024	21.132	19.239	16.716	14.824	12.931	10.408	8.516	6.623	4.100	2.208	.315
	Corn, 9; tankage, 1	29.270	28.262	27.253	21.769	20.760	19.752	14.267	13.259	12.250	6.766	5.757	4.749
	Corn, 19; tankage, 1	29.355	28.883	28.411	21.879	21.406	20.934	14.402	13.930	13.458	6.926	6.453	5.981
$8	Corn alone	28.860	28.860	28.860	22.027	22.027	22.027	15.194	15.194	15.194	8.360	8.360	8.360
	Corn, 4; tankage, 1	39.909	29.017	27.124	24.601	22.709	20.816	18.293	16.401	14.508	11.985	10.093	8.200
	Corn, 9; tankage, 1	37.675	36.667	35.658	30.174	29.165	28.157	22.672	21.664	20.655	15.171	14.162	13.154
	Corn, 19; tankage, 1	37.225	36.753	36.281	29.749	29.276	28.804	22.272	21.800	21.328	14.796	14.323	13.851
$9	Corn alone	35.030	35.030	35.030	28.197	28.197	28.197	21.364	21.364	21.364	14.530	14.530	14.530
	Corn, 4; tankage, 1	38.794	36.902	35.009	32.486	30.594	28.701	26.178	24.286	22.393	19.870	17.978	16.085
	Corn, 9; tankage, 1	46.080	45.072	44.063	38.579	37.570	36.562	31.077	30.069	29.060	23.576	22.567	21.559
	Corn, 19; tankage, 1	45.095	44.623	44.151	37.619	37.146	36.674	30.142	29.670	29.198	22.666	22.193	21.721
$10	Corn alone	41.200	41.200	41.200	34.367	34.367	34.367	27.534	27.534	27.534	20.700	20.700	20.700
	Corn, 4; tankage, 1	46.679	44.787	42.894	40.371	38.479	36.586	34.063	32.171	30.278	27.755	25.863	23.970
	Corn, 9; tankage, 1	54.485	53.477	52.468	46.984	45.979	44.967	39.482	38.474	37.465	31.981	30.972	29.964
	Corn, 19; tankage, 1	52 965	52.493	52.021	45.489	45.016	44.544	38.012	37.540	37.068	30.536	30.063	29.591

*Five pigs in each lot. Duration of test, 84 days. Average initial weight 144.1 pounds. Average final weight 295.75 pounds.

Since profit is influenced by the rate of gain and the selling price of hogs, as well as by the cost of gains, rations which produce gains at the lowest cost do not necessarily produce the greatest profit. This is strikingly shown in Table XII, which gives the difference between the cost of feed and the selling price of the gains produced with the varying prices of feed and hogs as shown in the table.

With corn at 42 cents per bushel, rations of corn, 9; tankage, 1; and of corn, 19; tankage, 1, proved more *costly* per unit of gain than one of corn alone, but the larger resulting rates of gain were sufficient to make either of the former rations more *profitable* than the one of corn alone.

That the relative price of corn and the supplemental feed used is a factor in determining the amount of supplement to feed in connection with the corn is demonstrated by the fact that, with hogs selling at $8 per hundredweight, and tankage valued at $42 per ton, Lot VI, fed corn, 9; tankage, 1, returned a greater profit than Lot VII, fed corn, 19; tankage, 1, while the latter returned the greater profit when tankage was valued at $54 per ton.

With corn at 42 cents per bushel, tankage at $48 per ton, and hogs selling at $7 or less per hundredweight, it was more profitable to feed a ration of corn alone than one of 4 parts of corn to 1 part of tankage. When hogs were $8 per hundredweight or above, with other feed at the prices just mentioned, it was more profitable to feed the latter ration. This shows the influence the value of the increase in live weight has on the amount of supplement to feed for greatest net returns.

As the price of corn approaches that of the supplemental feeds, it is more economical to use a greater amount of these feeds to the extent that such an addition will no longer result in reducing the feed requirement per unit of gain.

Inasmuch as the increased effectiveness of the ration more than offsets its greater cost per unit of weight, it is more profitable in the feeding of younger pigs to use a larger proportion of supplemental feed than was found most profitable in this experiment. A study of the foregoing tables will emphasize the importance of considering carefully both cost and efficiency of feeds in the selection of a ration. The results secured in this experiment indicate that, when pigs are well grown at the beginning of the fattening period, only a small amount of supplemental feed is needed.

TABLE XIII.—EXPERIMENT V: VARIOUS PROPORTIONS OF SUPPLEMENTS

(Feeding period divided into three parts of 4 weeks each)

	Lot I Corn alone	Lot II Corn, 2; soybeans, 1	Lot III Corn, 5; soybeans, 1	Lot IV Corn, 11; soybeans, 1	Lot V Corn, 4; tankage, 1	Lot VI Corn, 9; tankage, 1	Lot VII Corn, 19 tankage, 1	Lot VIII Corn, 5; linseed oilmeal, 1
FIRST PERIOD—								
Average daily gain.....pounds..	1.42	2.01	1.92	1.91	2.11	2.15	2.11	1.81
Average daily feed per pig								
Corn.....do....	6.279	5.029	5.851	6.282	5.659	6.602	6.986	5.530
Supplement.....do....	.....	2.514	1.170	.571	1.415	.734	.368	1.106
Total.....do....	6.279	7.543	7.021	6.853	7.074	7.336	7.354	6.636
Feed consumed per pound gain:								
Corn.....do....	4.417	2.501	3.051	3.282	2.681	3.076	3.310	3.048
Supplement.....do....	.....	1.250	.610	.298	.670	.342	.174	.610
Total.....do....	4.417	3.751	3.661	3.580	3.351	3.418	3.484	3.658
Cost of feed per pound gain*.....cents..	5.521	5.376	4.912	4.639	5.026	4.700	4.573	4.908
SECOND PERIOD—								
Average daily gain.....pounds..	1.66	1.65	1.65	1.72	1.91	2.19	1.98	1.83
Average daily feed per pig:								
Corn.....do....	6.786	4.700	5.929	6.584	6.451	7.708	7.858	6.661
Supplement.....do....	.....	2.350	1.186	.599	1.613	.856	.414	1.332
Total.....do....	6.786	7.050	7.115	7.183	8.064	8.564	8.272	7.993
Feed consumed per pound gain:								
Corn.....do....	4.086	2.855	3.585	3.817	3.376	3.526	3.964	3.643
Supplement.....do....	.....	1.427	.717	.347	.844	.392	.209	.729
Total.....do....	4.086	4.282	4.302	4.164	4.220	3.918	4.173	4.372
Cost of feed per pound gain.....cents..	5.108	6.137	5.772	5.396	6.330	5.388	5.478	5.866
THIRD PERIOD—								
Average daily gain.....pounds..	1.32	1.58	1.27	1.33	1.61	1.67	1.53	1.91
Average daily feed per pig:								
Corn.....do....	6.443	4.429	5.083	5.710	5.926	7.123	6.518	6.717
Supplement.....do....	.....	2.214	1.017	.519	1.481	.791	.343	1.343
Total.....do....	6.443	6.643	6.100	6.229	7.407	7.914	6.861	8.060
Feed consumed per pound gain:								
Corn.....do....	4.863	2.805	3.987	4.297	3.679	4.262	4.264	3.519
Supplement.....do....	.....	1.403	.797	.391	.920	.474	.224	.704
Total.....do....	4.863	4.208	4.784	4.688	4.599	4.736	4.488	4.223
Cost of feed per pound gain.....cents..	6.079	6.032	6.418	6.075	6.899	6.513	5.890	5.666

*Scale of prices given on page 5.

In Table XIII, Experiment V has been divided into three periods of 4 weeks each. This furnishes an opportunity for the study of the relative values of the various rations at different stages of the fattening period.

The most striking feature brought out by this table is the good results obtained from the use of corn alone for the first 8 weeks of the experiment. During the second 4-week period, the feed requirement per unit of gain for the corn-fed pigs was lower than that for any of the others with the exception of those which received 9 parts of corn to 1 part of tankage. The feed required per unit of gain by the pigs of Lot I was less for the second period than for the first. During the third period, however, they required more feed per pound of gain than any of the other lots and, with the exception of Lot III, made slower gains. When fed to well-developed hogs, corn alone will produce good gains for a short time; but, if the feeding is to be continued for any great length of time, corn should generally be supplemented with a small amount of some feed rich in protein and mineral matter. The results obtained from the other rations vary less from period to period. Lots II and VI consumed less feed per pound of gain during the third period than they did during the second. As the fattening period advanced, less feed was consumed daily per hundred pounds of live weight.

Of the pigs which received corn and soybeans, the proportion of 2 to 1 resulted in the largest gains for the first 4-week period, but the most feed per pound of gain was required. The proportion of 11 parts of corn to 1 part of soybeans resulted in a lower feed requirement per unit of gain in both the first and second 4-week periods, and, in the latter instance, resulted in the most rapid gains. For the third period the pigs fed the proportion of 2 parts of corn to 1 part of soybeans again made the most rapid gains and this time their feed consumption per pound of gain was less than that for the pigs fed proportions of 5 to 1 and 11 to 1. All the differences are too slight to be of certain importance, excepting to show the extravagance of feeding too much of high-priced supplements.

Of the pigs fed corn and tankage, those given the ration containing 10 percent of tankage gained at a higher rate for all three periods than any of the other lots. For the first period the pigs fed the narrow, for the second period those fed the medium and for the third period those fed the wide ration required the least feed to produce a unit of gain. For the entire 84 days the rate of gain and amount of feed consumed per unit of gain were both in favor of the ration containing 10 percent of tankage.

In a comparison of the various supplements, tankage was most consistent in producing economical gains. The ration containing soybeans gave excellent results for a time, but became relatively less effective as the experiment progressed. Linseed oilmeal, on the other hand, gave poor results at the beginning of the experiment, but developed from the next lowest rate of gain in the first period to the highest in the last. The average daily feed consumed by the pigs fed corn and linseed oilmeal decreased from 3.881 percent of the live weight for the first period to 2.958 percent of the live weight for the third period, while that of the corn and tankage fed pigs decreased from 4.208 to 2.736 percent of the live weight.

RELATIVE AMOUNTS OF CORN AND TANKAGE CONSUMED BY SELF-FED PIGS

EXPERIMENT VI

In an experiment in which a lot of six crossbred Duroc-Tamworth pigs, 3 months of age and averaging 71.75 pounds in weight when the experiment began, was fed corn and tankage in a self-feeder for a period of 14 weeks, the following results were obtained:

	Pounds
Initial weight, December 8, 1914	430.5
Final weight, March 16, 1915	1,313.0
Average daily gain	1.5
Corn consumed	3,180.9
Tankage consumed	260.0
Total feed consumed	3,440.9
Corn per pound gain	3.6
Tankage per pound gain	.29
Total feed per pound gain	3.89

TABLE XIV.—EXPERIMENT VI: WEEKLY PERCENTAGE OF TANKAGE CONSUMED

Week of test	Percentage of tankage in the ration
1	14.6
2	16.9
3	19.0
4	17.9
5	11.1
6	5.0
7	6.0
8	5.5
9	5.8
10	5.0
11	8.3
12	5.0
13	4.6
14	4.3

The pigs ate as an average for 14 weeks 12.4 parts of corn to 1 part of tankage. On a weekly basis the percentage of tankage

gradually increased during the first 3 weeks from 14.6 to 19 percent of the ration. At that time the pigs averaged 85.9 pounds in weight. During the next 3 weeks the percentage rapidly dropped to 5 percent. For the last 8 weeks of the test, with one exception, the amount of tankage in the ration varied less than 2 percent. Table XIV shows the weekly percentage of tankage consumed, while Diagram I shows the parts of corn to one part of tankage in the weekly feed consumed.

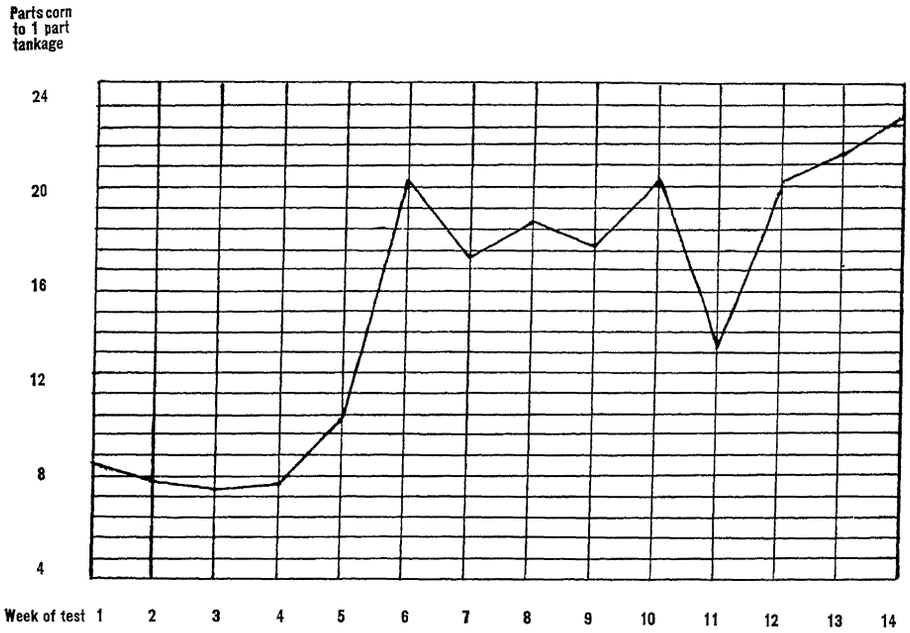

Diagram I.—Showing parts of corn to one part of tankage in weekly feed consumed by self-fed pigs of Experiment VI

The data for only the one lot are presented for the purpose of showing the percentages of corn and tankage that were consumed by the self-fed pigs in dry lot. The results of the entire experiment comparing self- and hand-feeding will be published after further tests have been conducted.

SKIMMILK AS A SUPPLEMENT TO CORN

The composition of skimmilk gives it a high value for the production of muscle and bone and makes it especially suitable to feed in connection with corn to growing pigs. As shown by the analysis given in Table I, on a dry-matter basis, it carries approximately 34.9 percent of crude protein and 7.9 percent of ash, or mineral

matter. During 1915 and 1916, three experiments were conducted for the purpose of comparing various proportions of skimmilk as a supplement to corn in dry-lot feeding.

EXPERIMENT VII

The pigs used in the first experiment were a little less than 4 months old at the beginning of the feeding period and averaged 58 pounds in weight at that time. Until then they had received a ration of corn, 14 parts; linseed oilmeal, 4 parts; and tankage, 1 part. The five lots were fed as follows:

Lot I: Corn, 9; tankage 1
Lot II: Corn, 1; skimmilk, 1
Lot III: Corn, 1; skimmilk, 3
Lot IV: Corn, 1; skimmilk, 5
Lot V: Corn and skimmilk, both ad libitum

The test began January 20 and was continued until March 31, 1915, a period of 70 days. At the end of 7 weeks, one pig was taken out of each lot. The results of this experiment are shown in Table XV. The feeds which in this and the following experiments are designated as having been fed ad libitum were not accessible at all times, but were fed at regular hours, the pigs being given all they would consume within 2 hours. Of the rations so designated, skimmilk was fed three times daily and the corn twice daily. No skimmilk was fed at noon on weigh days.

TABLE XV.—EXPERIMENT VII: VARIOUS PROPORTIONS OF CORN AND SKIMMILK

	Lot I Corn, 9; tankage, 1	Lot II Corn; 1; skimmilk, 1	Lot III Corn, 1; skimmilk, 3	Lot IV Corn, 1; skimmilk, 5	Lot V Corn and skimmilk, ad libitum
Average initial weight.....pounds..	56.7	61.7	59.3	54.6	58.4
Average final weight..... do....	125.375	155.0	133.125	149.5	178.5
Total gain.....do...	273.0	381.5	337.0	399.5	512.5
Average daily gain..... .....do....	.83	1.16	1.024	1.213	1.558
Feed consumed:					
Corn ....do....	1062.9	1227.0	896.0	870.5	871.0
Supplement.....do....	118.1	1227.0	2688.0	4352.5	8190.0
Total .....do....	1181.0	2454.0	3584.0	5223.0	9061.0
Average daily feed per pig:					
Corn .....do....	3.231	3.729	2.723	2.646	2.647
Supplement.....do....	.359	3.729	8.17	13.229	24.894
Total .....do....	3.59	7.459	10.894	15.875	27.541
Feed per pound gain:					
Corn.....do....	3.893	3.216	2.659	2.179	1.70
Supplement.....do....	.433	3.216	7.976	10.895	15.98
Total .....do....	4.326	6.432	10.635	13.074	17.68
Nutrients† per pound gain:					
Nonnitrogenous nutrients‡.....do....	3.502	2.777	2.581	2.349	2.234
Protein..... .....do....	.399	.404	.511	.563	.688
Total.....do....	3.901	3.181	3.092	2.912	2.922
Cost of feed per pound gain§..... cents..	5.948	4.663	4.918	4.903	5.320

*One pig taken out of each lot March 10. Lot I, 55 lb.; Lot II, 70 lb.; Lot III, 101 lb. Lot IV, 74.5 lb.; and Lot V, 90.5 lb.

†Nutrients determined from analyses of corn and tankage for Experiment V, and milk from analysis for Experiments VIII and IX.

‡Nonnitrogenous nutrients=carbohydrates plus (fat×2.25).

§Table of prices given on page 5.

In this and the following experiments, the total nutrients required to produce a pound of gain are shown for the purpose of giving a further basis of comparison between the rations of the check lots and the rations containing skimmilk. Since fat has a fuel value approximately 2.25 times as great as that of carbohydrates, to place it on a carbohydrate basis the fat content in each case has been multiplied by 2.25. The term "nonnitrogenous nutrients" includes the carbohydrates plus the fat multiplied by 2.25, but does not include the mineral content.

The ration of corn and tankage produced an average daily gain of 0.8 pound. This is a lower rate than usually results from the use of such a ration. The amount of corn and tankage consumed by the pigs of Lot I was less than the amount of corn consumed by Lot II, which received an equal weight of skimmilk in addition to the corn. With the exception of Lot III, each increase in the proportion of milk in the ration resulted in an increased rate of gain. An increased percentage of milk slightly decreased the daily corn consumption in each case, while the corn required per unit of gain was decreased to a still greater extent.

With the exception of the ration consisting of equal parts of corn and milk, the cost per pound of dry matter in the rations containing milk was higher than it was in the corn-and-tankage ration. The beneficial effect of the milk, however, was sufficiently great to make any of the rations that contained it less costly per pound of gain than the ration of corn and tankage.

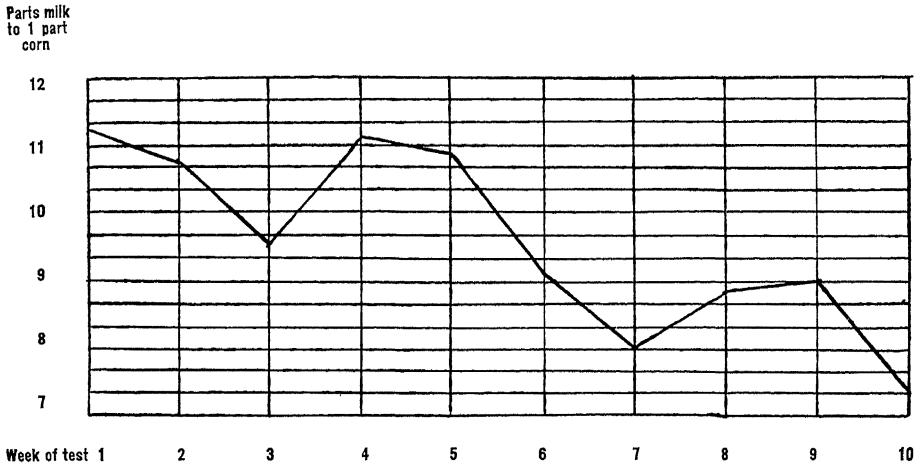

Diagram II.—Showing in weekly periods the ratio of milk to corn consumed by the pigs of Lot V in Experiment VII

Lot V, fed both corn and milk according to appetite, consumed, for the 10 weeks, an average of 9.4 pounds of milk for each pound of corn. Diagram II shows by weekly periods the proportions of milk and corn consumed.

It will be noted that the tendency was for the pigs to consume a smaller proportion of milk as the feeding period advanced.

TABLE XVI.—EXPERIMENT VII: REPLACEMENT AND MONEY VALUE OF SKIMMILK

	When 1 pound of ground corn was fed with			
	1 pound of skimmilk	3 pounds of skimmilk	5 pounds of skimmilk	Skimmilk, ad libitum or 9.4 lb.
Milk required to replace 100 lb. of corn and tankage	*Pounds* 289.73	*Pounds* 478.464	*Pounds* 507.452	*Pounds* 608.530
Amount of corn replaced	60.991	74.025	79.832	83.511
Amount of tankage replaced	39.009	25.975	20.168	16.489
Money value of skimmilk per hundred with corn at	*Cents*	*Cents*	*Cents*	*Cents*
42 cents per bushel	49.4	25.2	21.7	17.2
56 cents per bushel	54.7	29.0	25.7	20.5
70 cents per bushel	60.0	32.9	29.6	23.9
84 cents per bushel	65.2	36.8	33.5	27.4
Tankage at $50 per ton				

Table XVI sets forth the amount of skimmilk that was necessary in the different rations to replace 100 pounds of dry feed when compared with the ration of corn and tankage. From these data the money value of skimmilk in comparison with the corn and tankage ration has been computed and should be of value to the feeder in determining the proportions of milk and corn to feed for greatest economy. When a surplus of milk is at hand, the larger allowance will increase the rate of gain, but cannot be expected to give as great a return for an equal quantity of milk. With larger pigs, a lower value for the skimmilk has been shown. The high replacement value of the skimmilk is partly due to the poorer results than usual which were obtained from the use of corn and tankage, which in turn is probably partly due to the fact that tankage is not so well suited for use by young pigs as skimmilk is.

In Table XVII the feeding period has been divided into two periods of 5 weeks each. This table shows that during the second period there was less difference than during the first in the rate and cost of gains of the pigs fed corn and tankage and of those fed corn and various proportions of milk. This is true also of the total nutrients required per unit of gain. The advantage of skimmilk

decreased as the age of the pigs increased. The feed requirement per unit of gain was much higher for the second period than it was for the first.

TABLE XVII.—EXPERIMENT VII: VARIOUS PROPORTIONS OF CORN AND SKIMMILK

	Lot I Corn, 9; tankage, 1	Lot II Corn, 1; skimmilk, 1	Lot III Corn, 1; skimmilk, 3	Lot IV Corn, 1; skimmilk, 5	Lot V Corn and skimmilk, ad libitum
FIRST PERIOD—					
Average daily gain.....pounds.	0.737	1.249	1.003	1.154	1.611
Average daily feed per pig;					
Corn.....do...	2.69	3.569	2.466	2.111	2.097
Supplement.....do....	.299	3.569	7.397	10.557	22.334
Feed consumed per pound gain:					
Corn.....do....	3.649	2.858	2.459	1.829	1.301
Supplement.....do...	.405	2.858	7.376	9.146	13.860
Nutrients per pound gain:					
Nonnitrogenous nutrients.....do...	3.095	2.467	2.387	1.972	1.797
Protein.....do....	.580	.359	.472	.473	.581
Total.....do....	3.675	2.826	2.859	2.445	2.378
Cost of feed per pound gain*.....cents..	5.57	4.14	4.55	4.12	4.40
SECOND PERIOD—					
Average daily gain.....pounds..	.935	1.058	1.049	1.282	1.497
Average daily feed per pig:					
Corn.....do....	3.845	3.912	3.016	3.253	3.273
Supplement.....	.427	3.912	9.049	16.266	27.802
Feed consumed per pound gain:					
Corn.....do....	4.112	3.696	2.876	2.537	2.187
Supplement.....do...	.457	3.696	8.628	12.684	18.575
Nutrients per pound gain:					
Nonnitrogenous nutrients.....do...	3.488	3.190	2.791	2.735	2.768
Protein.....do....	.654	.464	.552	.656	.819
Total.....do....	4.142	3.654	3.343	3.391	3.587
Cost of feed per pound gain.....cents..	6.28	5.36	5.32	5.71	6.45

Note—Nutrients estimated from analyses of corn and tankage of Experiment V and milk from analysis for Experiments VIII and IX.
*Scale of prices given on page 5.

EXPERIMENT VIII

Spring pigs were fed in this experiment that had previously been used in hogging down rye. They averaged 79 pounds in weight and were between 4 and 5 months old at the time the test began. It was the plan to have five lots of five pigs each fed as follows:

Lot I: Corn alone
Lot II: Corn, 9; tankage, 1
Lot III: Corn, 1; skimmilk, 1
Lot IV: Corn and skimmilk, ad libitum[1]
Lot V: Skimmilk alone

The experiment lasted from August 25 to December 8, 1915 (15 weeks) with the results as given in Table XVIII.

The feeding of tankage in addition to corn resulted in almost doubling the rate of gain and in reducing by almost 20 percent the total nutrients required per unit of gain. The use of skimmilk as a

[1]Because of a shortage in the milk supply, the pigs of Lot IV were fed only what milk was available rather than all they would consume.

supplement had a similar desirable effect. Lot III fed equal parts of corn and skimmilk consumed 32.265 percent more corn than Lot I, which received a ration of corn alone. The lot fed skimmilk alone consumed less and the one fed corn alone more total nutrients per unit of gain than any of the other lots, which were not greatly different in this respect.

TABLE XVIII.—EXPERIMENT VIII: VARIOUS PROPORTIONS OF CORN AND SKIMMILK

	Lot I Corn alone	Lot II Corn, 9; tankage, 1	Lot III Corn, 1; skimmilk, 1	Lot IV Corn, plus skimmilk as available	Lot V Skimmilk alone
Average initial weight .....pounds..	79.7	78.6	79.1	78.6	78.2
Average final weight.....do....	172.2	258.1	250.8	263.6	196.1
Total gain.....do....	462.5	897.5	858.5	925.0	589.5
Average daily gain.....do....	.881	1.709	1.635	1.762	1.123
Feed consumed:					
Corn.....do....	2200.5	3086.55	2910.5	3151.0	.....
Supplement.....do....	.....	342.95	2893.5	3800.0	19259.0
Total.....do....	2200.5	3429.50	5804.0	6951.0	19259.0
Average daily feed per pig:					
Corn.....do....	4.19	5.879	5.543	6.002	.....
Supplement.....do....	.....	.653	5.511	7.238	36.684
Total.....do....	4.19	6.532	11.054	13.240	36.684
Feed consumed per pound gain:					
Corn.....do....	4.758	3.439	3.39	3.406	.....
Supplement.....do....	.....	.382	3.37	4.108	32.67
Total.....do....	4.758	3.821	6.76	7.514	32.67
Nutrients per pound gain:					
Nonnitrogenous nutrients .....do....	3.697	2.758	2.815	2.867	1.753
Protein.....do....	.397	.520	.395	.421	1.086
Total.....do....	4.094	3.278	3.210	3.288	2.839
Cost of feed per pound gain*.....cents..	5.95	5.25	4.91	5.08	6.53

*Scale of prices given on page 5.

The average amount of milk consumed by the pigs of Lot IV was 1.2 pounds per pound of corn. Their rate of gain was slightly higher than that of Lot III. This was probably due to a more desirable distribution of the milk rather than to the slightly larger amount fed. For the first part of the test they received a much larger proportion of milk than Lot III but for the latter part they were given less milk than corn. The amounts are given in Table XXII, page 31.

In Table XIX is given the amount of milk (in the various rations containing it) that was required to replace 100 pounds of feed of the corn-and-tankage ration. The table also shows the money value of skimmilk as determined from its replacement value, with corn at the prices given in the table and tankage at the constant price of $50 per ton. The value for skimmilk when fed with an equal weight of corn is much lower than in the preceding experiment. This probably is due to the fact that larger pigs were used and the feed requirement per unit of gain by the corn-and-tankage-

fed pigs was much lower, while the rate of gain was considerably higher.

TABLE XIX.—EXPERIMENT VIII: REPLACEMENT AND MONEY VALUE OF SKIMMILK

	When 1 pound of ground corn was fed with		When skimmilk alone was fed
	1 pound of skimmilk	1.2 pounds of skimmilk (see text regarding distribution)	
Milk required to replace 100 lb. of corn and tankage	*Pounds* 781.903	*Pounds* 989.880	*Pounds* 855.012
Amount of corn replaced	11.346	7.928	90.000
Amount of tankage replaced	88.654	92.072	10.000
Money value of skimmilk per hundred with corn at	*Cents*	*Cents*	*Cents*
42 cents per bushel	29.4	23.9	10.8
56 cents per bushel	29.8	24.1	13.4
70 cents per bushel	30.2	24.3	16.1
84 cents per bushel	30.5	24.5	18.7
Tankage at $50 per ton			

The supplemental value of tankage and of skimmilk in the various proportions used in the test as compared with the ration of corn alone are given in Table XXVII on page 47.

The manner in which the cost of gains is affected by the relative prices of feeds is illustrated in Table XX, which gives the cost per hundred pounds increase in live weight with varying prices for corn and milk. The tankage is valued at $50 per ton. It should be understood that the cheapest gains are not necessarily the most profitable ones.

TABLE XX.—EXPERIMENT VIII: INFLUENCE OF VARYING FEED PRICES UPON THE COST OF GAINS

Prices of corn and milk; (tankage charged at $50 per ton)		Cost of feed per 100 pounds gain				
Corn per bushel	Milk per cwt.	Lot I Corn alone	Lot II Corn, 9; tankage, 1	Lot III Corn, 1; skimmilk, 1	Lot IV Corn plus skimmilk as available	Lot V Skimmilk alone
Cents	*Cents*	*Dollars*	*Dollars*	*Dollars*	*Dollars*	*Dollars*
42	15	3.57	3.53	3.05	3.17	4.90
56	15	4.76	4.39	3.90	4.02	4.90
70	15	5.95	5.25	4.74	4.87	4.90
84	15	7.14	6.11	5.59	5.73	4.90
42	20	3.57	3.53	3.22	3.38	6.53
56	20	4.76	4.39	4.06	4.23	6.53
70	20	5.95	5.25	4.91	5.08	6.53
84	20	7.14	6.11	5.76	5.93	6.53
42	25	3.57	3.53	3.39	3.58	8.17
56	25	4.76	4.39	4.23	4.43	8.17
70	25	5.95	5.25	5.08	5.29	8.17
84	25	7.14	6.11	5.93	6.14	8.17
42	30	3.57	3.53	3.55	3.79	9.80
56	30	4.76	4.39	4.40	4.64	9.80
70	30	5.95	5.25	5.25	5.49	9.80
84	30	7.14	6.11	6.10	6.34	9.80

Table XXI shows the difference between the cost of feed and the selling price of the gains produced by the lots of Experiment VIII, fed (1) corn alone, (2) corn and skimmilk, equal parts by weight and (3) skimmilk alone. The values shown represent the margins (above the cost of feed only) yielded by each of the three lots with the various prices of feed and hogs as given in the table.

TABLE XXI.—EXPERIMENT VIII: THE DIFFERENCE PER LOT BETWEEN THE COST OF FEED AND THE VALUE OF GAINS PRODUCED

Hogs per cwt.	Ration	Value of gain minus cost of feed								
		Corn 56c per bushel			Corn 70c per bushel			Corn 84c per bushel		
		Skimmilk per hundredweight								
		15c	20c	25c	15c	20c	25c	15c	20c	25c
$7	Corn alone	$5.744	$5.744	$ 5.744	$0.243	$0.243	$0.243	$-5.259	$-5.259	$5.259
	Corn, 1; skimmilk, 1	18.067	16.621	15.174	10.791	9.345	7.898	3.516	2.069	.622
	Skimmilk alone	6.482	—3.148	—12.777	6.482	—3.148	—12.777	6.482	—3.148	—12.777
$8	Corn alone	14.994	14.994	14.994	9.493	9.493	9.493	3.991	3.991	3.991
	Corn, 1; skimmilk, 1	35.237	33.791	32.344	27.961	26.515	25.068	20.686	19.239	17.792
	Skimmilk alone	18.272	8.642	— .987	18.272	8.642	— .987	18.272	8.642	— .987
$9	Corn alone	19.619	19.619	19.619	14.118	14.118	14.118	8.616	8.616	8.616
	Corn, 1; skimmilk, 1	43.822	42.376	40.929	36.546	35.100	33.653	29.271	27.824	26.377
	Skimmilk alone	24.167	14.537	4.908	24.167	14.537	4.908	24.167	14.537	4.908

The rations of corn alone and of skimmilk alone gave remarkably poor returns as compared with the ration composed of equal parts of corn and skimmilk. Which of the rations composed of one feed alone resulted in a greater profit or smaller loss than the other depended upon the relative prices of the two feeds and the price of hogs. At the prices given in the table, the lot fed equal parts of corn and skimmilk, with the exception of three price conditions, returned a greater margin above the cost of feed than the combined returns of the lot fed corn alone and the lot fed skimmilk alone. The conditions which were exceptions to this were the cases in which the selling price of hogs was $8 and $9 per hundredweight with the corn and skimmilk priced at 84 cents per bushel and 15 cents per hundredweight, respectively, and the case in which the selling price of hogs was $9 per hundredweight, the price of corn 70 cents per bushel and that of milk 15 cents per hundredweight.

The five pigs consumed 2,910.5 pounds of corn and 2,893.5 pounds of skimmilk, or 2,755.8 pounds of total nutrients, while the 10 consumed 2,200.5 pounds of corn and 19,259 pounds of skimmilk, or a total of 3,567.1 pounds of nutrients. These results show something of the economic importance of supplementing a carbonaceous

feed with a sufficient amount of feed rich in protein and of the economic folly of feeding a highly nitrogenous feed alone rather than feeding it with corn or other feed of a similar nature.

In Table XXII, the total time of the experiment has been divided into three periods of 5 weeks each. The value of the rations used as shown by the results secured can thus be compared for the different stages of the fattening period and for pigs of the age of those used in this experiment.

TABLE XXII.—EXPERIMENT VIII: VARIOUS PROPORTIONS OF CORN AND SKIMMILK

(Feeding period divided into three parts of 5 weeks each)

	Lot I Corn alone	Lot II Corn, 9; tankage, 1	Lot III Corn, 1; skimmilk, 1	Lot IV Corn plus skimmilk as available	Lot V Skimmilk alone
FIRST PERIOD—					
Average daily gain.....pounds.	0.809	1.271	1.434	1.98	1.497
Average daily feed per pig:					
Corn .....do....	3.7	3.816	4.091	4.283	.....
Supplement.....do....	.....	.424	3.994	10.166	29.277
Feed consumed per pound gain:					
Corn .....do...	4.576	3.002	2.853	2.163	.....
Supplement.....do. ..	.....	.333	2.785	5.134	19.555
Nutrients per pound gain:					
Nonnitrogenous nutrients.....do....	3.556	2.408	2.367	1.956	1.049
Protein.....do....	.382	.454	.331	.351	.650
Total .....do....	3.938	2.862	2.698	2.307	1.699
Cost of feed per pound gain*.....cents..	5.72	4.585	4.123	3.731	3.911
SECOND PERIOD—					
Average daily gain.....pounds..	1.023	1.929	2.023	1.777	.90
Average daily feed per pig:					
Corn .....do....	4.471	6.177	5.934	6.606	.....
Supplement.....do....	.....	.686	5.934	6.748	38.334
Feed consumed per pound gain:					
Corn.....do...	4.372	3.203	2.934	3.717	.....
Supplement.....do....	.....	.356	2.934	3.797	42.594
Nutrients per pound gain:					
Nonnitrogenous nutrients ....do....	3.397	2.569	2.437	3.092	2.285
Protein..... .....do...	.365	.484	.343	.437	1.416
Total..... .....do....	3.762	3.053	2.780	3.529	3.701
Cost of feed per pound gain.....cents..	5.464	4.893	4.254	5.406	8.519
THIRD PERIOD—					
Average daily gain.....pounds..	.811	1.929	1.449	1.529	.971
Average daily feed per pig:					
Corn.....do....	4.403	7.645	6.606	7.117	.....
Supplement.....do...	.....	.849	6.606	4.800	42.440
Feed consumed per pound gain:					
Corn.....do....	5.426	3.964	4.56	4.656	.....
Supplement. .....do....	.....	.440	4.56	3.140	43.688
Nutrients per pound gain:					
Nonnitrogenous nutrients.....do....	4.217	3.179	3.789	3.787	2.344
Protein.....do....	.453	.600	.532	.493	1.453
Total .....do....	4.670	3.779	4.321	4.280	3.797
Cost of feed per pound gain .....cents..	6.783	6.056	6.612	6.448	8.738

*Scale of prices given on page 5.

For the first 5 weeks of the test the lots which received skimmilk alone gained more rapidly and required less nutrients per unit of gain than either the pigs fed corn or those fed corn and tankage. The favorab[1] esults for the period from the use of skimmilk proba-

bly were due in part to "fill." That the use of skimmilk in comparison with tankage is more beneficial during the early part of the feeding period than later is indicated by the foregoing results and the fact that for the last 5 weeks of the test the highest rate of gain and the least nutrients necessary to produce a unit of gain resulted from the use of corn and tankage. In other experiments (see pages 27 and 48) skimmilk gave better results as compared with tankage when fed to pigs while young than when fed to the same pigs when older.

Throughout the entire test, the pigs fed corn alone consumed a greater amount of nutrients per unit of gain than any of the other lots for the same period.

With the one exception of the corn-and-tankage-fed pigs for the second period, the average daily feed consumed per 100 pounds of live weight decreased for each succeeding period. It is shown from this that in proportion to their weight, young pigs are able to consume a greater amount of feed than older ones. The average daily consumption of dry matter for the pigs fed only skimmilk decreased from 2.67 percent of the live weight for the first period to 2.256 percent for the third period, which would approximate, respectively, 3.26 and 2.76 gallons of skimmilk for each 100 pounds of live weight. The decrease in the daily consumption of dry matter per 100 pounds live weight for the pigs fed skimmilk alone was less than that for the pigs given corn and skimmilk, showing that the former were growing rather than fattening.

The rations of corn alone and of skimmilk alone had a noticeable effect upon the character of gains. Since the pigs were well grown at the beginning of the test, those fed corn alone gained more rapidly than is usually the case with younger pigs similarly fed. Unlike those which received a nitrogenous supplement in addition to the corn, they failed to produce a normal growth of bone and muscle but laid on an abundance of fat, which resulted in the chuffy appearance so characteristic of corn-fed hogs. On the other hand, the pigs fed skimmilk exclusively produced growthy frames, but remained thin in condition and rough in appearance.

Table XXIII gives, for the various lots, the average live and dressed weights, the dressing percentage and the width of the fat back at the fourth vertebra. The hogs were killed at Canton, Ohio, and the shrinkage in transit was not determined. The live weights were taken at the Experiment Station 2 days before slaughtering, so that the dressing percentages perhaps are lower than they would have been had shrinkage been taken into consideration. It is believed that the comparisons were not interfered with.

TABLE XXIII.—EXPERIMENT VIII: SLAUGHTER TEST

Average for	Ration	Live weight at Wooster, Ohio, December 8	Warm dressed weight at Canton, Ohio, December 10	Dressing percentage	Width of fat back at fourth vertebra
		Pounds	*Pounds*	*Percent*	*Inches*
Lot I.....	Corn alone.....	172.2	133.4	77.47	2.15
Lot II.....	Corn, 9; tankage, 1.....	258.1	203.8	78.96	2.55
Lot III.....	Corn, 1; skimmilk, 1.....	250.8	203.4	81.1	2.5
Lot IV. ...	Corn, skimmilk as available. ..	263.6	217.6	82.5	2.725
Lot V	Skimmilk alone..... ...	196.1	148.8	75.9	1.775

EXPERIMENT IX

This experiment was conducted for the purpose of securing further data on the use of various proportions of corn and skimmilk for fattening swine. Seven lots of five pigs each were used and started on the following rations:

Lot I: Corn alone
Lot II: Corn, 9; tankage, 1
Lot III: Corn, 1; skimmilk, 1
Lot IV: Corn, 1; skimmilk, 3
Lot V: Corn, 1; skimmilk, 5
Lot VI: Corn and skimmilk, both ad libitum
Lot VII: Skimmilk alone for 4 weeks; then skimmilk as available with corn, ad libitum

Lot VII received milk alone for the first 4 weeks. At that time, due to increased consumption, there was a shortage in the supply of milk. Corn was then added to the ration of the pigs in Lot VII, and they were given the milk available after that for the other lots had been set aside. This averaged 4.95 pounds of skimmilk to each pound of corn fed and did not vary greatly from day to day.

Throughout the experiment all the lots had access to salt, ground limestone and rock phosphate (floats) in separate containers.

When placed on feed shortly after weaning time, the pigs averaged 43.6 pounds in weight. Before weaning, a part of them had been allowed to eat with their dams and the rest had been fed separately, but given the same kind of feed, which consisted of corn, 14 parts; linseed oilmeal, 2 parts; and tankage, 1 part. After weaning they were given the same feed until the beginning of the experiment. A part of the pigs had been allowed the range of a bluegrass lot, while the others had been confined. The different lots were made up of pigs that, on the average, had been treated alike. The experiment began December 17, 1915, and lasted until March 31, 1916, a period of 15 weeks. The results secured are shown in Table XXIV.

TABLE XXIV.—EXPERIMENT IX: VARIOUS PROPORTIONS OF CORN AND SKIMMILK FOR PIGS

	Lot I Corn	Lot II Corn, 9; tankage, 1	Lot III Corn, 1; skimmilk, 1	Lot IV Corn, 1; skimmilk, 3	Lot V Corn, 1; skimmilk, 5	Lot VI Corn and skimmilk, ad libitum	Lot VII Corn, ad libitum; skimmilk as available (see text)
Average initial weight ..... pounds	43.0	43.5	43 3	44.3	44.3	44 0	42.8
Average final weight* ..... do..	79.8	156.333	148.125	196 875	189.8	210.8	204.4
Total gain ..... do..	184.0	421.5	421.5	660.0	727.5	834.0	808.0
Average daily gain ..... do...	.35	.899	.956	1.328	1.386	1.589	1.539
Feed consumed:							
Corn ..... do..	1,260.5	1,476.0	1,392.5	1,694.0	1,700.0	1,672.0	1,521.5
Supplement ..... do..	.....	164.0	1,390.5	5,082.0	8,495.0	10,777.5	11,322.0
Total ..... do...	1,260.5	1,640.0	2,783.0	6,776.6	10,195.0	12,449.5	12,843.5
Average daily feed per pig:							
Corn ..... do....	2.401	3.147	3.158	3.408	3.238	3.185	2.898
Supplement ..... do...	.....	.350	3.153	10.225	16.181	20.529	21.566
Total ..... do....	2.401	3.497	6.311	13.633	19.419	23.714	24.464
Feed consumed per pound gain:							
Corn ..... do...	6.85	3.502	3.304	2.567	2.337	2.005	1.883
Supplement ..... do...	.....	.389	3.299	7.800	11.677	12 923	14.012
Total ..... do....	6.85	3.891	6.603	10.267	14.014	14.928	15.895
Nutrients per pound of gain:							
Nonnitrogenous nutrients ..... do....	5.443	2.87	2.802	2.453	2.484	2.287	2.248
Protein ..... do....	.579	.533	.389	.473	.586	.599	.625
Total ..... do...	6.022	3.403	3.191	2.926	3 070	2.886	2.873
Cost of feed per pound gain† ..... cents.	8.56	5.35	4.79	4.75	5.26	5 09	5.16

*One pig taken out of Lot III, January 7, weight 45.5 lb.; two pigs taken out of Lot II, March 3, weight 107 and 63 lb.; one pig taken out of Lot IV, March 3, weight 94 lb.

†Scale of prices given on page 5.

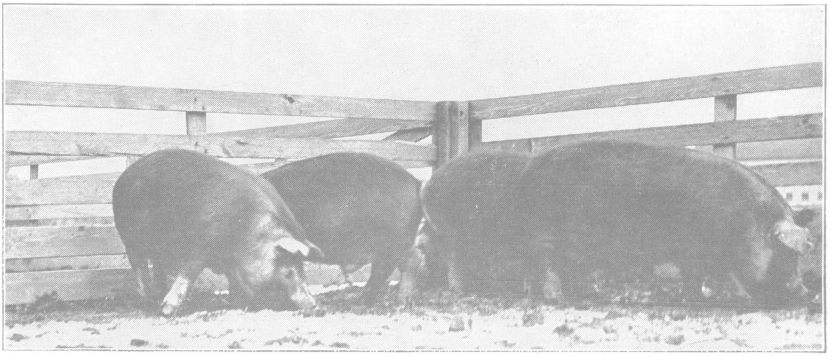

Fig. 1.—Hogs in Lot I of Experiment VIII, fed corn alone

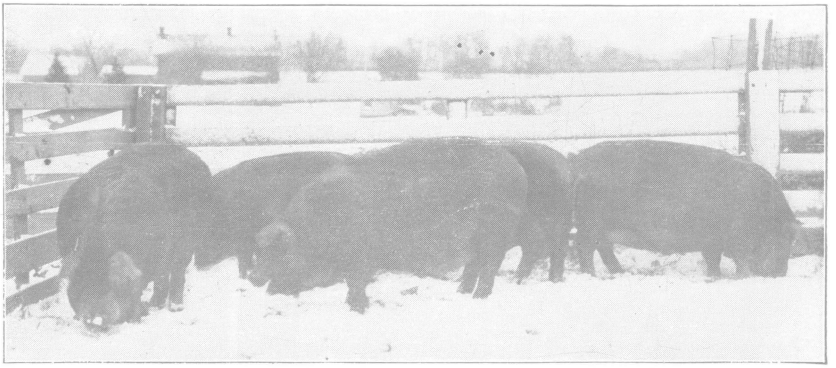

Fig. 2.—Hogs in Lot II of Experiment VIII, fed nine parts of corn to one part of tankage

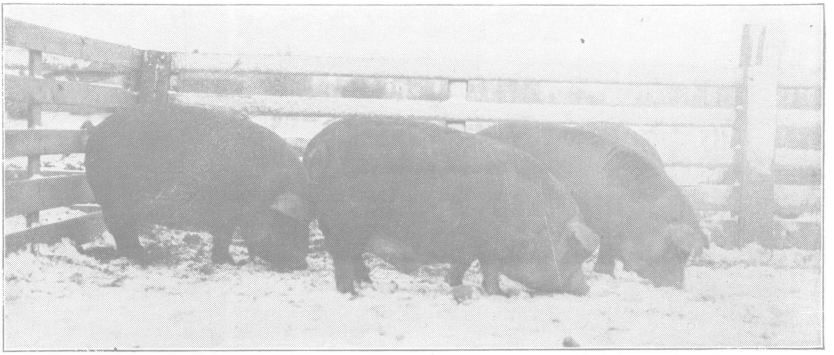

Fig. 3.—Hogs in Lot III of Experiment VIII, fed equal parts of corn and skimmilk

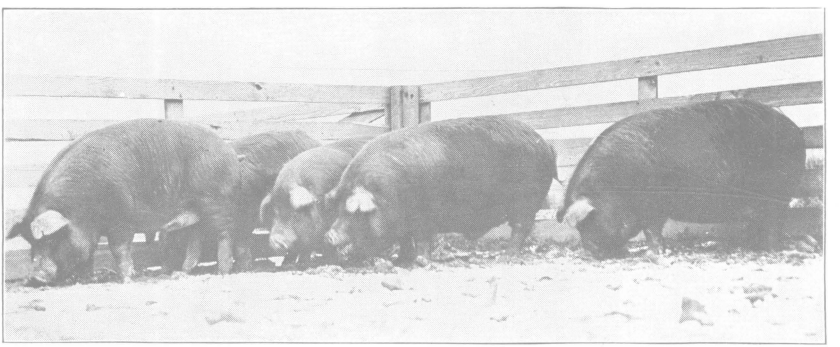

Fig. 4.—Hogs in Lot IV of Experiment VIII, fed corn and skimmilk as available

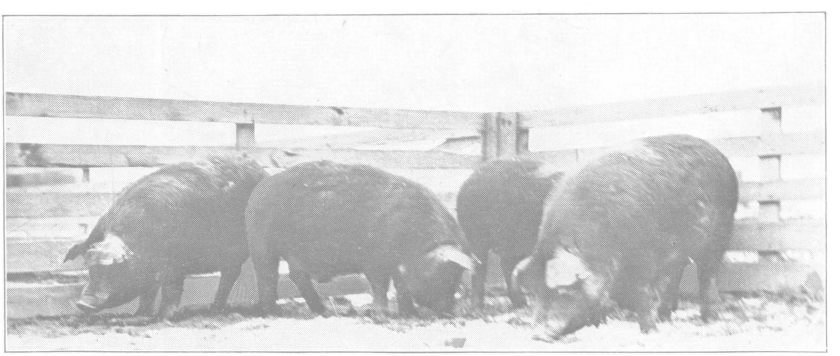

Fig. 5.—Hogs in Lot V of Experiment VIII, fed skimmilk alone

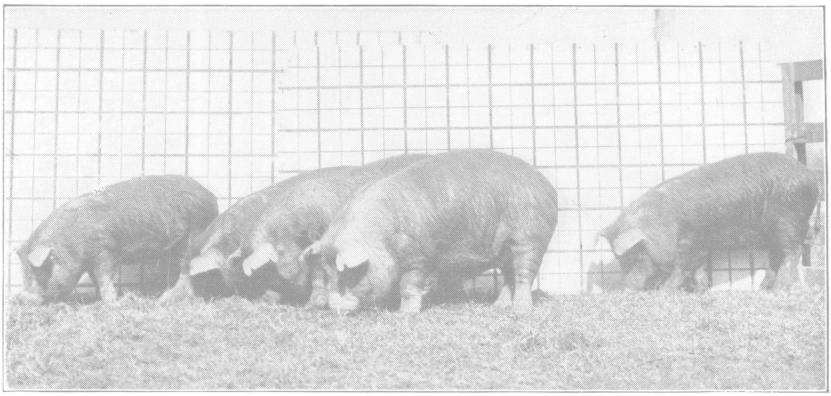

Fig. 6.—Hogs in Lot I of Experiment IX, fed corn alone

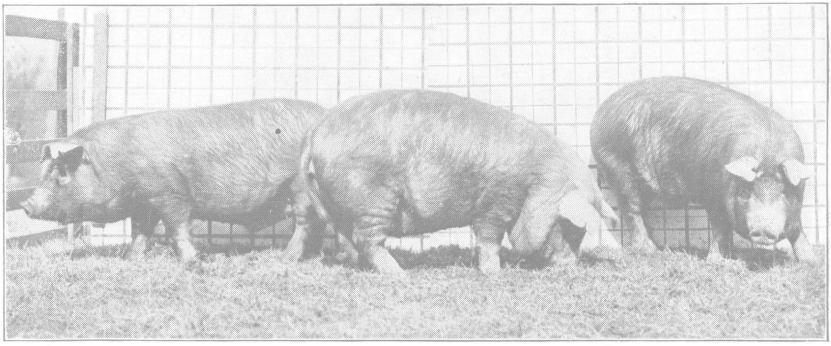

Fig. 7.—Hogs in Lot II of Experiment IX, fed nine parts of corn to one part of tankage

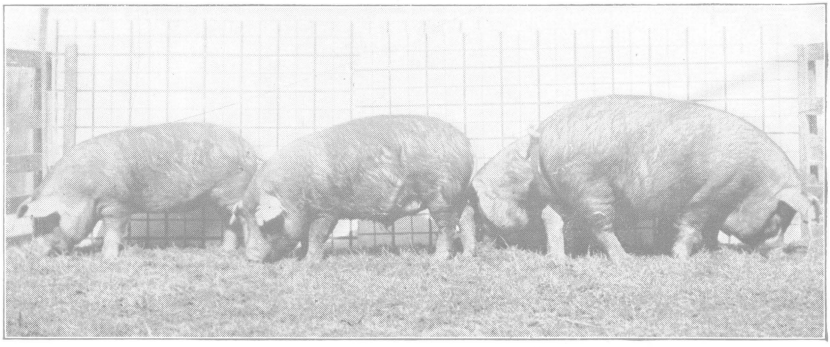

Fig. 8.—Hogs in Lot III of Experiment IX, fed equal parts of corn and skimmilk

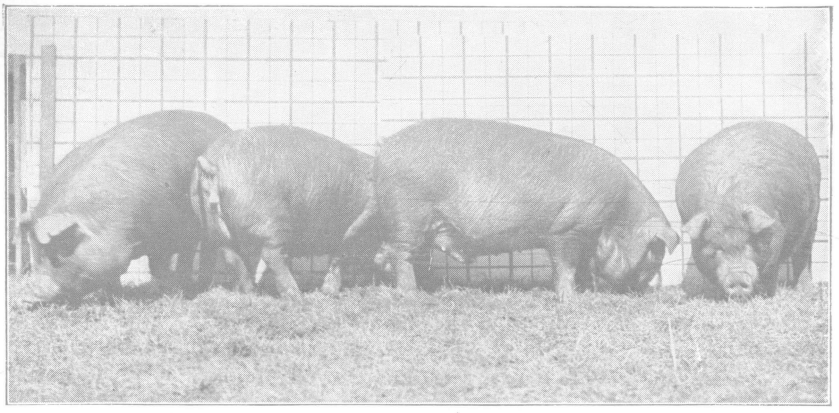

Fig. 9.—Hogs in Lot IV of Experiment IX, fed one part of corn to three parts of skimmilk

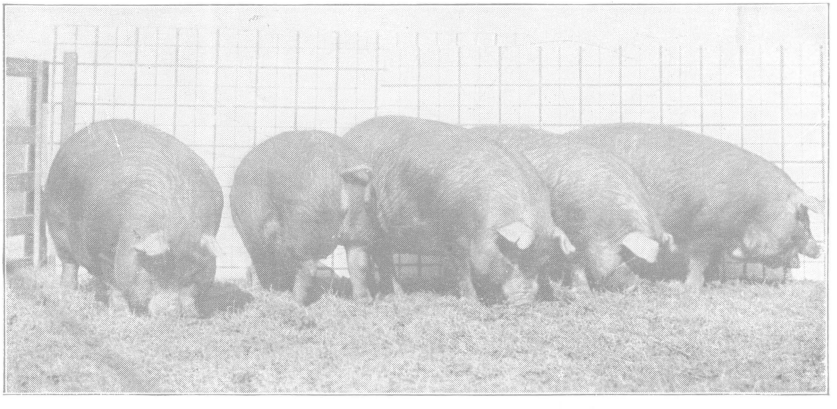

Fig. 10.—Hogs in Lot V of Experiment IX, fed one part of corn to five parts of skimmilk

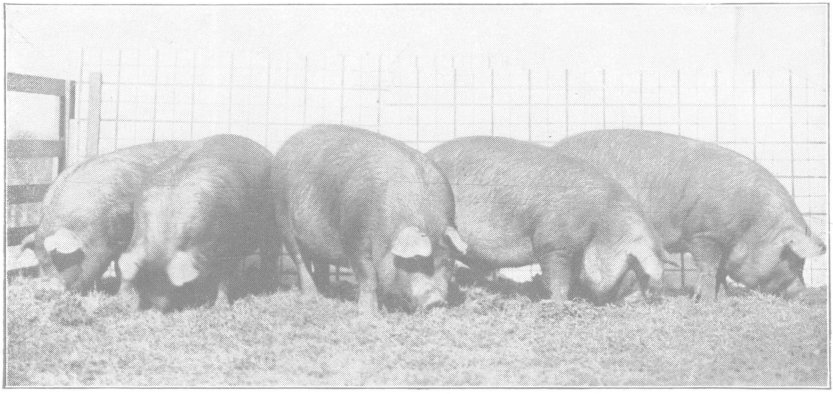

Fig. 11.—Hogs in Lot VI of Experiment IX, fed corn and skimmilk ad libitum

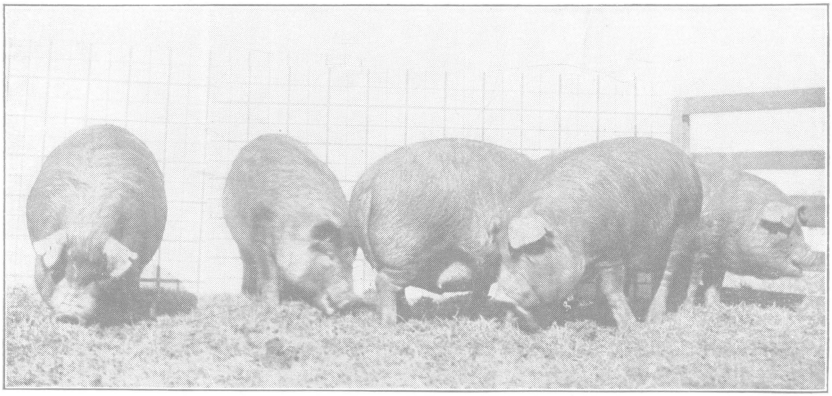

Fig. 12.—Hogs in Lot VII of Experiment IX, fed corn ad libitum and skimmilk as available (average, 1:7.4)

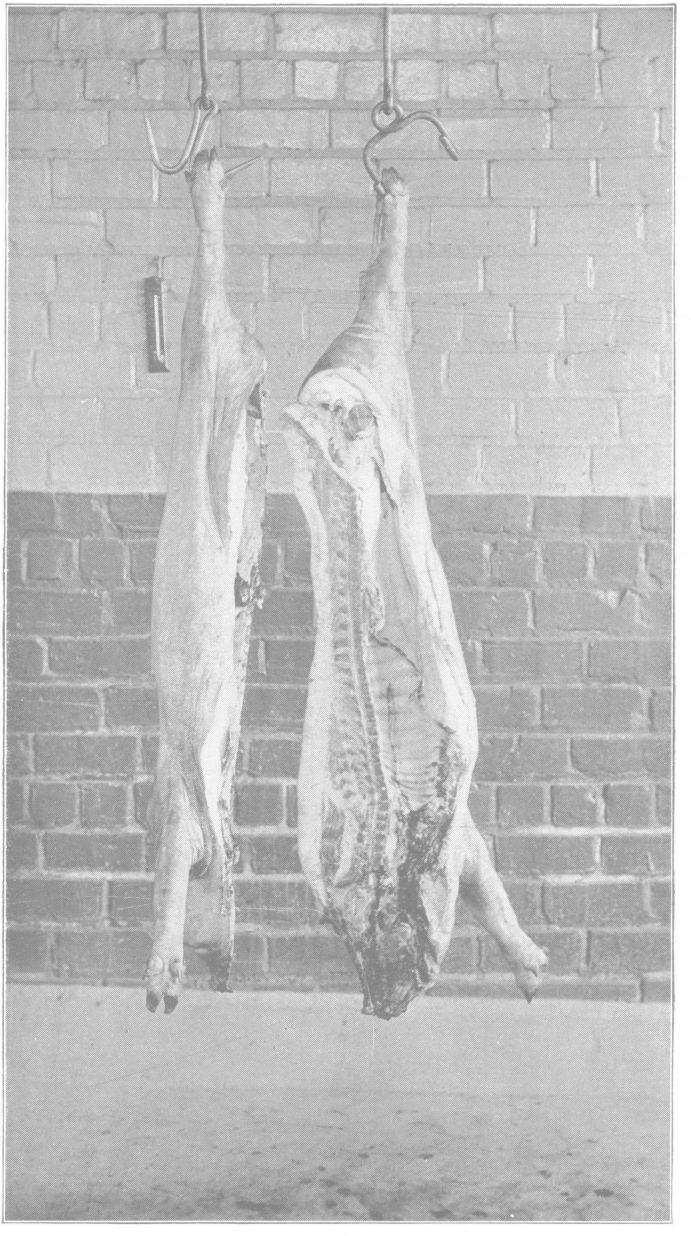

Fig. 13.—Carcass of hog in Lot I of Experiment IX, fed corn alone; average dressed weight of two representative hogs in lot, 75.75 pounds

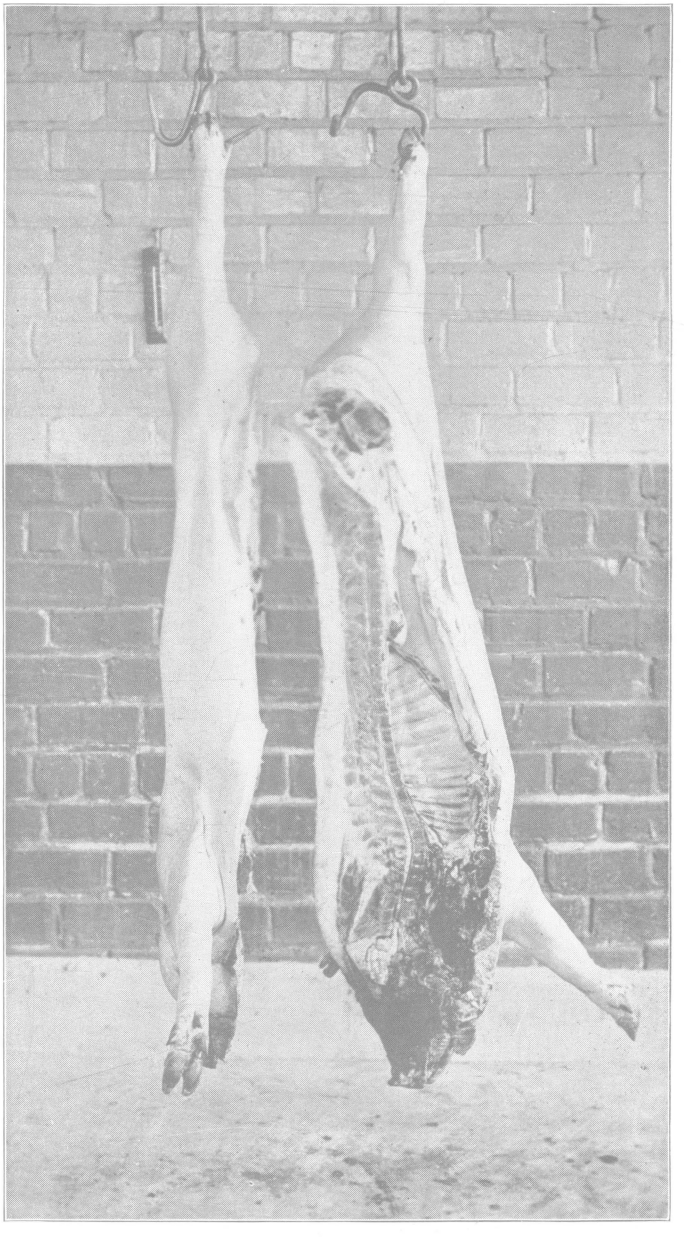

Fig. 14.—Carcass of hog in Lot II of Experiment IX, fed nine parts of corn to one part of tankage; average dressed weight of two representative hogs in lot, 138.6 pounds

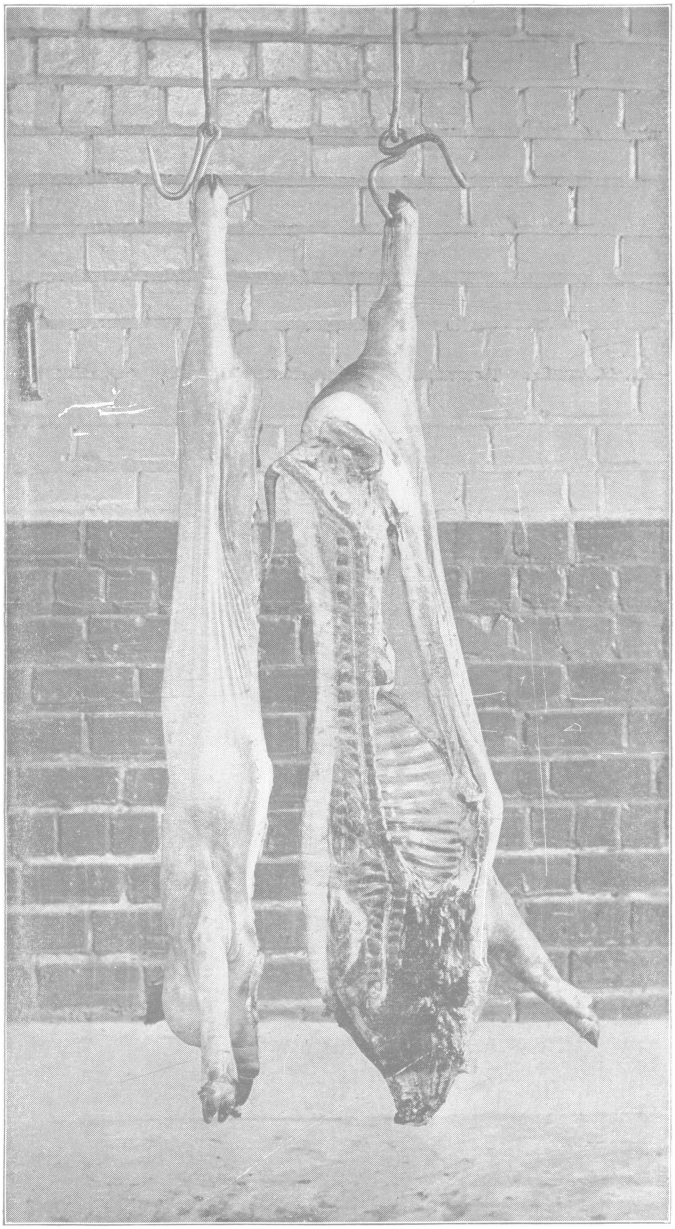

Fig. 15.—Carcass of hog in Lot III of Experiment IX, fed equal parts of corn and skimmilk; average dressed weight of two representative hogs in lot, 119.95 pounds

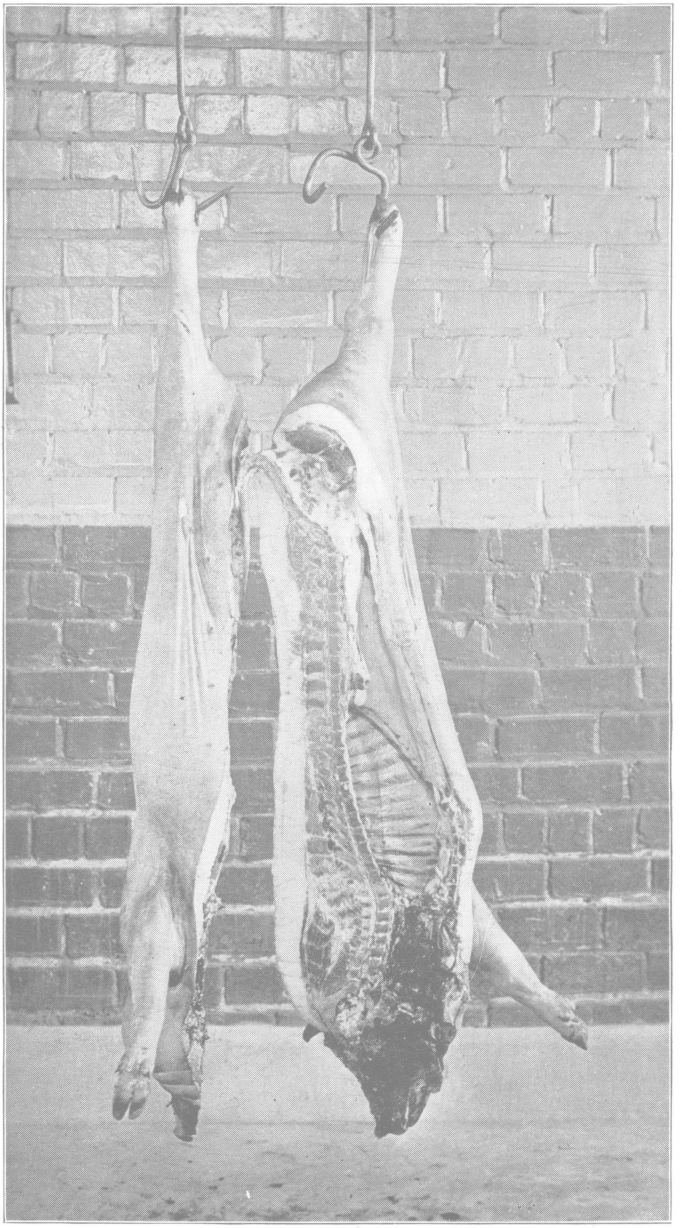

Fig. 16.—Carcass of hog in Lot V of Experiment IX, fed one part of corn to five parts of skimmilk; average dressed weight of two representative hogs in lot, 153.95 pounds

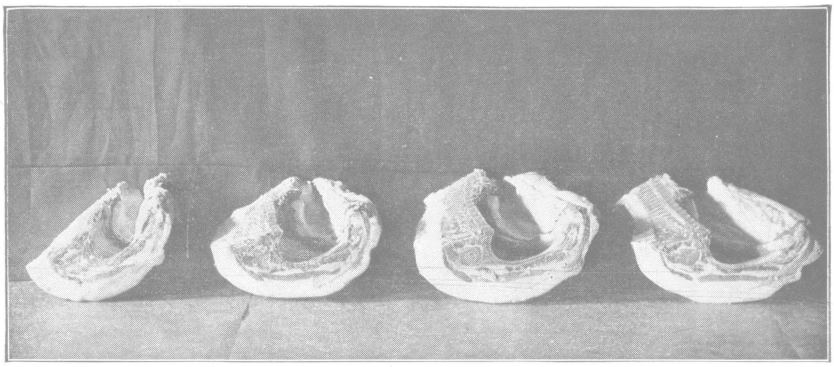

Fig. 17.—Sides of representative carcasses from hogs fed (1) corn alone; (2) corn, 9; tankage, 1; (3) corn, 1; skimmilk, 1; and (4) corn, 1; skimmilk, 5, in Experiment IX

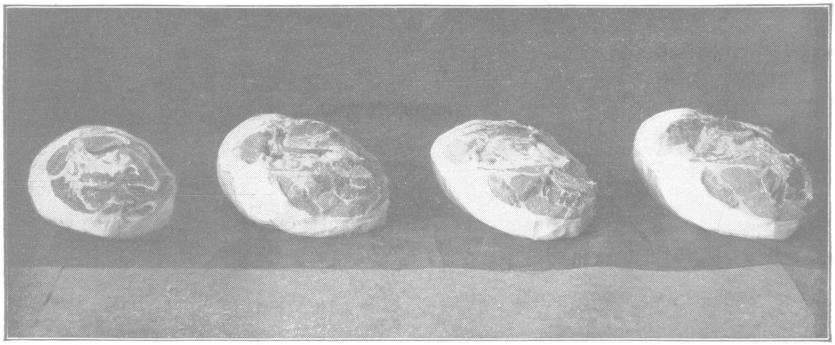

Fig. 18.—Hams of representative carcasses from hogs fed (1) corn alone; (2) corn, 9; tankage, 1; (3) corn, 1; skimmilk, 1; and (4) corn, 1; skimmilk, 5, in Experiment IX

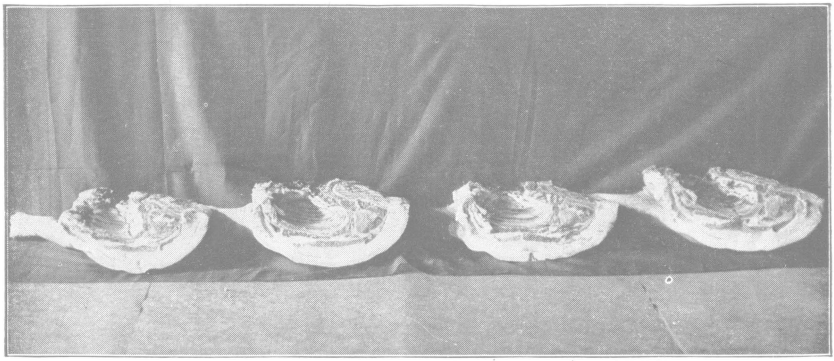

Fig. 19.—Rough shoulders of representative carcasses fed (1) corn alone; (2) corn, 9; tankage, 1; (3) corn, 1; skimmilk, 1; and (4) corn, 1; skimmilk, 5, in Experiment IX

The rate of gain which resulted from the use of corn and tankage was lower than that for any of the rations which contained skimmilk. With Lot VII excluded, each increase in the proportion of skimmilk in the ration resulted in an increase in the rate of gain and a decrease in the amount of corn required per unit of gain. With the exception of Lot V, fed skimmilk and corn in the ratio of 5 to 1, the total nutrients required per pound of gain decreased with each increase in the proportion of skimmilk.

The pigs fed corn alone made an exceedingly poor showing. Their average gain was 0.35 pound daily. They ate less feed, made more costly gains and had a lower market value than the pigs of any of the other lots. That this was due to the ration fed is shown by the fact that two representative pigs of the lot, which were retained after the close of this 15-week experiment and placed on a ration of corn and skimmilk, fed in the proportions demanded by their appetites, made an average gain for 8 weeks of 1.598 pounds daily, with a feed requirement of 2.103 pounds of corn and 11.254 pounds of milk per pound of increase in live weight. This was after an interval of 10 days had elapsed following the addition of milk to the ration. Table XXV gives the results secured.

TABLE XXV.—EXPERIMENT IX: RESULTS FROM FEEDING TWO REPRESENTATIVE PIGS FROM LOT I ON CORN AND SKIMMILK

	Lot I December 17 to March 31	Two representative pigs of Lot I, April 10 to June 5
Ration	Corn alone	Corn and skimmilk, ad lib.
Average weight, March 31....pounds..	79.8	81.5
Average daily gain....do....	.35	1.598
Feed consumed per pound gain:		
Corn....do....	6.85	2.103
Skimmilk....do....	.....	11.254
Nutrients per pound gain:		
Nonnitrogenous nutrients....do....	5.443	2.275
Protein....do....	.579	.552
Total....do....	6.022	2.827
Cost of feed per pound gain*....cents.	8.56	4.88

*Scale of prices given on page 5.

These data show that the pigs which made slow gains on corn alone were capable of making good gains when given a properly balanced ration. The pigs were in a healthy condition; otherwise they would not have done so well after the addition of skimmilk to the ration.

The pigs in Lot VI consumed an average of 6.446 pounds of skimmilk per pound of corn. The ratio of skimmilk to corn gradually increased from 4.75 pounds of milk to 1 pound of corn during the first week to 8.44 pounds of milk to 1 pound of corn during the

fifth week. From the seventh to the fifteenth week, the proportion of milk slowly decreased. Diagram III gives in weekly periods the proportions consumed.

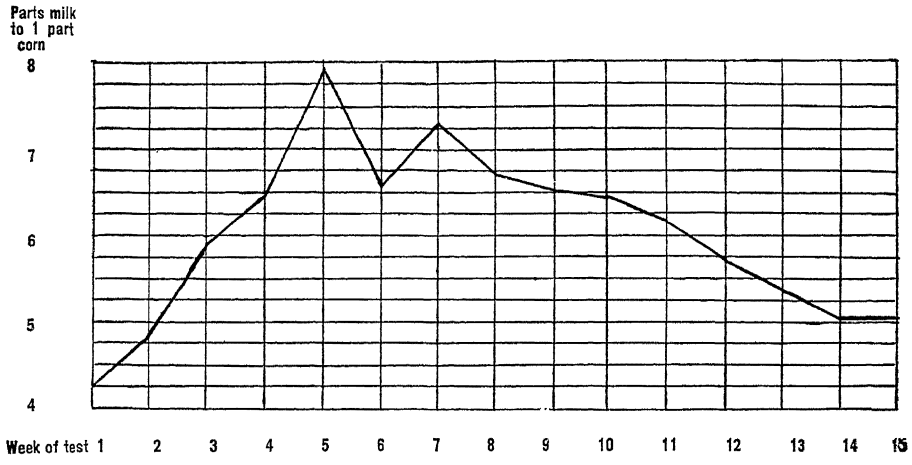

Diagram III.—Showing in weekly periods the ratio of milk to corn consumed by the pigs of Lot VI in Experiment IX

Table XXVI shows the quantity of skimmilk in each ration that was required to replace 100 pounds of corn and tankage and shows the feeding value of skimmilk when fed with corn in comparison with the corn-and-tankage ration.

TABLE XXVI.—EXPERIMENT IX: REPLACEMENT AND MONEY VALUE OF SKIMMILK

	When 1 pound of ground corn was fed with			
	1 pound of skimmilk	3 pounds of skimmilk	5 pounds of skimmilk	An average of 6.446 pounds of skimmilk (see text)
Milk required to replace 100 lb. of corn and tankage	*Pounds* 562.01	*Pounds* 581.571	*Pounds* 751.416	*Pounds* 685.207
Amount of corn replaced	33.731	70.619	74.968	79.374
Amount of tankage replaced	66.269	29.381	25.032	20.626
Money value of skimmilk per hundred with corn at	*Cents*	*Cents*	*Cents*	*Cents*
42 cents per bushel	33.980	21.737	15.811	16.213
56 cents per bushel	35.480	24.773	18.305	19.109
70 cents per bushel	36.981	27.809	20.799	22.005
84 cents per bushel	38.481	30.844	23.294	24.901
Tankage at $50 per ton				

The higher replacement value of the skimmilk in this experiment over that of the preceding one is probably due to the fact that younger pigs were used. Although the proportion of milk was greater, the ration that contained all that the pigs would consume

of both corn and milk gave a higher value for the milk than did the ration of 1 part corn to 5 parts milk. The relatively large consumption (see Diagram III) of skimmilk by this lot during most of the experiment should be noted.

TABLE XXVII.—EXPERIMENTS VIII AND IX: VALUE OF SUPPLEMENT IN COMPARISON WITH RATION OF CORN ALONE

Experiment	Corn, 9; tankage, 1	Corn, 1; skimmilk, 1	Corn, 1; skimmilk, 3	Corn, 1; skimmilk, 5	Corn and skimmilk, ab lib., or 1 to 6.446 pounds	Skimmilk alone
	Supplement required to replace 100 pounds of corn					
	Pounds	*Pounds*	*Pounds*	*Pounds*	*Pounds*	*Pounds*
VIII	28.967	246.345	.....	.....	.....	686.633
XI	11.619	93.034	179.781	258.741	266.749	.....
	Dry matter in amount of supplement required to replace 100 pounds of corn					
	Pounds	*Pounds*	*Pounds*	*Pounds*	*Pounds*	*Pounds*
VIII	26.204	23.452	.....	.....	.....	65.367
IX	10.511	8.857	17.115	24.631	25.393	.....
	Replacement value of supplement per pound of dry matter with corn at 70c per bushel					
	Cents	*Cents*	*Cents*	*Cents*	*Cents*	*Cents*
VIII	4.77	5.33	.....	.....	.....	1.91
IX	11.89	14.11	7.3	5.07	4.92	.....

In Table XXVII are given the relative value of tankage and of various proportions of skimmilk as supplements when compared with the rations of corn alone in Experiments VIII and IX. When determined in this way on a dry-matter basis, it is possible to secure a fairly accurate comparison of the two supplements. In both experiments the dry matter of skimmilk when fed with equal parts of corn was worth somewhat more than an equal weight of the dry matter of tankage fed with corn in the ratio of 1 to 9. In comparison with the replacement value of tankage per pound of dry matter, the dry matter of skimmilk had a higher relative replacement value when it was fed to the younger pigs of Experiment IX than it did when fed to the older pigs of Experiment VIII. The amount of skimmilk needed to replace 100 pounds of corn was directly proportional to the percentage of milk in the ration.

In Table XXVIII, Experiment IX has been divided into three periods of 5 weeks each, thus making possible a study of the results secured from the use of the various rations at different stages of the experiment.

TABLE XXVIII.—EXPERIMENT IX: VARIOUS PROPORTIONS OF CORN AND SKIMMILK
(Feeding period divided into three parts of 5 weeks each)

	Lot I Corn alone	Lot II Corn, 9; tankage, 1	Lot III Corn, 1; skimmilk, 1	Lot IV Corn, 1; skimmilk, 3	Lot V Corn, 1; skimmilk, 5	Lot VI Corn and skimmilk, ad libitum	Lot VIII Corn and skimmilk (skimmilk alone for first four weeks)
FIRST PERIOD—							
Average daily gain.....pounds..	0.326	0.491	0.472	0.986	1.086	1.229	1.089
Average daily feed per pig:							
Corn.....do...	2.126	1.926	1.854	2.037	1.963	1.837	.32
Supplement.....do....	.....	.214	1.854	6.111	9.814	11.863	24.551
Feed consumed per pound gain:							
Corn.....do....	6.526	3.919	3.928	2.067	1.808	1.495	.294
Supplement.....do....	.....	.435	3.928	6.200	9.039	9.656	22.554
Nutrients per pound gain:							
Nonnitrogenous nutrients.....do....	5.186	3.212	3.332	1.975	1.922	1.706	1.444
Protein.....do....	.551	.597	.463	.381	.453	.447	.775
Total.....do....	5 737	3.809	3.795	2.356	2.375	2.153	2.219
Cost of feed per pound gain*.....cents..	8.16	5.99	5.70	3.82	4.07	3.80	4.88
SECOND PERIOD—							
Average daily gain.....pounds..	.386	.943	1 064	1.274	1.471	1.837	1.800
Average daily feed per pig:							
Corn.....do....	2.340	2.973	3.039	3.286	3.274	3.186	3.314
Supplement.....do....	.....	.330	3.025	9.857	16.343	22.891	16.503
Feed consumed per pound gain:							
Corn.....do....	6.067	3.153	2.856	2.578	2.225	1.734	1.841
Supplement.....do....	.....	.35	2.842	7.735	11.107	12.460	9.168
Nutrients per pound gain:							
Nonnitrogenous nutrients.....do....	4.821	2.584	2.422	2.463	2.364	2.046	1.955
Protein.....do....	.513	.48	.336	.475	.557	.561	.461
Total.....do....	5.334	3.064	2.758	2.938	2.921	2.607	2.416
Cost of feed per pound gain.....cents..	7.58	4.82	4.14	4.77	5.00	4.66	4.14
THIRD PERIOD—							
Average daily gain.....pounds..	.340	1.433	1.404	1.799	1.600	1.700	1.729
Average daily feed per pig:							
Corn.....do....	2.737	5.202	4.775	5.187	4.477	4.531	5.060
Supplement.....do....	.....	.578	4.775	15.561	22.386	26.831	23.643
Feed consumed per pound gain:							
Corn.....do....	8.05	3.629	3.402	2.883	2.798	2.666	2.927
Supplement.....do....	.....	.403	3.402	8.648	13.991	15.783	13.678
Nutrients per pound gain:							
Nonnitrogenous nutrients.....do....	6.397	2.975	2.886	2.755	2.974	2.965	3.060
Protein.....do....	.680	.553	.401	.531	.702	.750	.702
Total.....do....	7.077	3.528	3.287	3.286	3.676	3.715	3.762
Cost of feed per pound gain.....cents .	10.06	5.54	4.93	5.33	6.30	6.49	6.39

*Scale of prices given on page 5.

At no time during the experiment did the rate and economy of gains of the lot fed corn alone compare favorably with those of the lots fed the other rations. The pigs fed corn and tankage and those fed corn and skimmilk, equal parts by weight, did not make large gains at first, but the rate of gain in live weight increased as the experiment progressed, until, in the third period, it amounted to 1.433 and 1.404 pounds daily, respectively. Because of a greater feed requirement per unit of gain, the cost was higher than that for the preceding period. With hogs selling at 8 cents per pound, the gross profit above the cost of feed was greater for the third period than for the second. This is true of both lots.

The lots of pigs fed larger amounts of skimmilk made excellent gains from the beginning. During the second 5-week period the rate of gain for Lots VI and VII amounted to 1.8 pounds per head daily, but this rate was not quite maintained during the third period. For the last four lots, the total nutrients necessary to produce a pound of gain increased with each succeeding period.

For the first and second periods, the rate of gain and the total nutrients required per pound of gain were in favor of Lot VI, fed corn and skimmilk, ad libitum, as compared with the lots fed smaller proportions of skimmilk, or the one fed corn and tankage. For the third period, however, these lots required less total nutrients to produce a pound of gain than Lot VI, and the difference in rate of gain was not so great as in the two preceding periods. This would indicate that the skimmilk was more beneficial during the first part of the feeding period than it was after the hogs became more nearly finished.

Table XXIX, showing the cost of feed per 100 pounds increase in live weight from the various rations with varying market prices for corn and milk, gives some idea of the importance the relative prices of the two feeds have in determining the proportion of each to feed for cheapest gains.

With corn at 84 cents per bushel and skimmilk at 15 cents per hundredweight, a ration of corn and skimmilk, ad libitum, averaging 6.446 parts of milk to 1 part of corn, resulted in the cheapest gains; but with corn at the same price and milk at 30 cents per hundredweight, the ration of equal parts of corn and skimmilk produced the cheapest gains. With corn at 42 cents and skimmilk at 30 cents, the difference in favor of the latter ration was still greater.

TABLE XXIX.—EXPERIMENT IX: INFLUENCE OF PRICE AND PROPORTIONS OF FEEDS UPON COST OF GAINS

Prices of corn and milk (tankage charged at $50 per ton)		Cost of feed per 100 pounds gain					
Corn per bushel	Milk per cwt.	Lot I Corn alone	Lot II Corn, 9; tankage, 1	Lot III Corn, 1; skimmilk, 1	Lot IV Corn, 1; skimmilk, 3	Lot V Corn, 1; skimmilk, 5	Lot VI Corn and skimmilk, ad libitum*
Cents	*Cents*	*Dollars*	*Dollars*	*Dollars*	*Dollars*	*Dollars*	*Dollars*
42	15	5.14	3.60	2.97	3.08	3.50	3.44
56	15	6.85	4.47	3.80	3.72	4.09	3.94
70	15	8.56	5.35	4.62	4.36	4.67	4.44
84	15	10.28	6.23	5.45	5.01	5.26	4.95
42	20	5.14	3.60	3.14	3.47	4.09	4.09
56	20	6.85	4.47	3.96	4.11	4.67	4.59
70	20	8.56	5.35	4.79	4.75	5.26	5.09
84	20	10.28	6.23	5.62	5.39	5.84	5.59
42	25	5.14	3.60	3.30	3.85	4.67	4.73
56	25	6.85	4.47	4.13	4.49	5.26	5.24
70	25	8.56	5.35	4.95	5.13	5.84	5.74
84	25	10.28	6.23	5.78	5.78	6.42	6.24
42	30	5.14	3.60	3.47	4.24	5.26	5.38
56	30	6.85	4.47	4.29	4.88	5.84	5.88
70	30	8.56	5.35	5.12	5.52	6.42	6.38
84	30	10.28	6.23	5.95	6.16	7.01	6.88

*An average of 1 part of corn to 6.446 parts of skimmilk was consumed.

Table XXX shows the difference between the cost of the feed consumed and the selling price of the gains produced by each lot during the time of the experiment with the varying prices for hogs and feed as given in the table. In order to be as nearly comparable as possible with the data for the lots from which no pigs were removed, the data for Lots II, III and IV from which pigs were taken before the experiment was completed are based on an equivalent number of total pig days (525).

It should be understood that these values represent the gross returns minus the cost of feed and do not take into consideration the labor, interest and other overhead charges. A comparison of Tables XXIX and XXX will show that the ration which costs the least per pound of gain produced is not necessarily the most profitable one. With corn at 42 cents per bushel and skimmilk at 15 cents per hundredweight, the ration of equal parts of corn and skimmilk produced gains at the lowest cost per pound, but the profit from the lot so fed was less than that from other lots receiving skimmilk in the ration. When corn was valued at 84 cents per bushel and skimmilk at 20 cents per hundredweight, the ration of one part of corn to three parts of skimmilk produced gains at the lowest cost. With hogs at 6 cents per pound, this ration also resulted in the most profit, but with hogs at 7 cents per pound, or higher, the ration of 1 part of corn to 6.446 parts of skimmilk showed the most profit.

TABLE XXX.—EXPERIMENT IX: DIFFERENCE BETWEEN THE COST OF FEED AND THE SELLING PRICE OF THE GAINS PRODUCED

		Value of gain minus cost of feed*											
Skimmilk per hundredweight		15c	20c	25c	15c	20c	25c	15c	20c	25c	15c	20c	25c
Tankage per ton		$42	$48	$54	$42	$48	$54	$42	$48	$54	$42	$48	$54
Hogs per cwt.	Ration	Corn 42 cents per bushel			Corn 56 cents per bushel			Corn 70 cents per bushel			Corn 84 cents per bushel		
$6	Corn alone	$1.59	$1.59	$1.59	$—1.56	$—1.56	$—1.56	$—4.72	$—4.72	$—4.72	$—7.87	$—7.87	$—7.87
	Corn, 9; tankage, 1	12.07	11.51	10.96	7.94	7.38	6.83	3.81	3.25	2.70	— .32	— .88	—1.43
	Corn, 1; skimmilk, 1	15.19	14.36	13.54	11.05	10.22	9.39	6.90	6.08	5.25	2.76	1.93	1.10
	Corn, 1; skimmilk, 3	20.36	17.67	14.99	15.88	13.20	10.52	11.41	8.73	6.04	6.94	4.25	1.57
	Corn, 1; skimmilk, 5	18.16	13.91	9.66	13.91	9.66	5.41	9.66	5.41	1.16	5.41	1.16	—3.09
	Corn and skimmilk, ad libitum†	21.33	15.94	10.56	17.15	11.76	6.38	12.97	7.58	2.20	8.79	3.40	—1.98
$7	Corn alone	3.43	3.43	3.43	.27	.27	.27	—2.88	—2.88	—2.88	—6.03	—6.03	—6.03
	Corn, 9; tankage 1	16.79	16.23	15.68	12.65	12.10	11.55	8.52	7.97	7.42	4.39	3.84	3.29
	Corn, 1; skimmilk, 1	20.21	19.38	18.55	16.06	15.24	14.41	11.92	11.09	10.27	7.78	6.95	6.12
	Corn, 1; skimmilk, 3	27.33	24.64	21.96	22.86	20.17	17.49	18.38	15.70	13.01	13.91	11.22	8.54
	Corn, 1; skimmilk, 5	25.43	21.18	16.94	21.18	16.93	12.69	16.93	12.68	8.44	12.68	8.43	4.19
	Corn and skimmilk, ad libitum†	29.67	24.28	18.90	25.49	20.10	14.72	21.31	15.92	10.54	17.13	11.74	6.36
$8	Corn alone	5.27	5.27	5.27	2.11	2.11	2.11	—1.04	—1.04	—1.04	—4.19	—4.19	—4.19
	Corn, 9; tankage, 1	21.50	20.95	20.40	17.37	16.82	16.27	13.24	12.69	12.14	9.11	8.56	8.01
	Corn, 1; skimmilk, 1	25.23	24.40	23.57	21.08	20.26	19.43	16.94	16.11	15.28	12.79	11.97	11.14
	Corn, 1; skimmilk, 3	34.30	31.62	28.93	29.83	27.14	24.46	25.35	22.67	19.99	20.88	18.20	15.51
	Corn, 1; skimmilk, 5	32.71	28.46	24.21	28.46	24.21	19.96	24.21	19.96	15.71	19.96	15.71	11.46
	Corn and skimmilk, ad libitum†	38.01	32.62	27.26	33.83	28.44	23.06	29.65	24.26	18.88	25.47	20.08	14.70
$9	Corn alone	7.11	7.11	7.11	3.96	3.96	3.96	.80	.80	.80	—2.35	—2.35	—2.35
	Corn, 9; tankage, 1	26.22	25.67	25.12	22.09	21.54	20.99	17.96	17.41	16.85	13.83	13.27	12.72
	Corn, 1; skimmilk, 1	30.24	29.42	28.59	26.10	25.27	24.45	21.96	21.13	20.29	17.81	16.98	16.16
	Corn, 1; skimmilk, 3	41.27	38.59	35.90	36.80	34.11	31.43	32.32	29.64	26.96	27.85	25.17	22.48
	Corn, 1; skimmilk, 5	39.98	35.73	31.49	35.73	31.48	27.24	31.48	27.23	22.99	27.23	22.98	18.74
	Corn and skimmilk, ad libitum†	46.35	40.96	35.58	42.17	36.78	31.40	37.99	32.60	27.22	33.81	28.42	23.04
$10	Corn alone	8.95	8.95	8.95	5.79	5.79	5.79	2.64	2.64	2.64	— .51	— .51	— .51
	Corn, 9; tankage, 1	30.94	30.38	29.83	26.81	26.25	25.70	22.68	22.12	21.57	18.55	17.99	17.44
	Corn, 1; skimmilk, 1	35.26	34.44	33.61	31.12	30.29	29.46	26.97	26.15	25.32	22.83	22.00	21.17
	Corn, 1; skimmilk, 3	48.24	45.56	42.88	43.77	41.09	38.40	39.30	36.61	33.93	34.82	32.14	29.45
	Corn, 1; skimmilk, 5	47.26	43.01	38.76	43.01	38.76	34.51	38.76	34.51	30.26	34.51	30.26	26.01
	Corn and skimmilk, ad libitum†	54.69	49.30	43.92	50.51	45.12	39.74	46.33	40.94	35.56	42.15	36.76	31.38

*Based on a total of 525 days for each lot.
†An average of 1 part corn to 6.446 parts of skimmilk was consumed.

With corn valued at 84 cents per bushel and skimmilk at 25 cents per hundredweight, rations composed of corn and milk, 1 to 1 and 1 to 3, were on a par so far as cost of gains was concerned. With hogs selling at 8 cents a pound, or lower, the latter ration was the most profitable of all the rations containing skimmilk. With hogs at 9 and 10 cents a pound, the ration of corn and skimmilk in the proportion of 1 to 6.446 resulted in a greater return than either of the foregoing rations.

Slaughter test.—At the close of the test two representative pigs from each of four lots were slaughtered; and their dressed weights and weights of the internal organs, together with the width of the fat back at the fourth vertebra, were secured. Since two average pigs of Lot I were reserved and continued on feed, it was necessary to slaughter a larger and a smaller pig of that lot, but the average of the two should be approximately representative of the lot. The results of this test are given in Table XXXI. The pigs were slaughtered in the afternoon after receiving a light feed in the morning. The live weights were taken a short time before and the dressed weights soon after slaughtering.

In addition to making much slower and more costly gains, the corn-fed pigs were worth less on the market than those fed some supplement in addition to corn. Besides being discriminated against because of their small size and poor quality, their lower dressing percentages would have made the corn-and-tankage-fed pigs of Lot II 2.5 percent more valuable; the pigs of Lot III, fed equal parts of corn and skimmilk, 2.16 percent more valuable; and the pigs of Lot V, fed five parts of skimmilk to each part of corn, 4.09 percent more valuable. If the pigs fed corn alone were valued at $8 per hundredweight, the ones fed corn and tankage would have been worth $8.20; those fed equal parts of corn and skimmilk, $8.17; and those fed five parts of skimmilk to one part of corn, $8.33, on the assumption that the carcasses were of equal value per pound, a point which cannot be determined without a more detailed examination than was made of these carcasses.

TABLE XXXI.—EXPERIMENT IX: SLAUGHTER TEST

Lot	Ration	No.	Live weight	Warm dressed weight	Dressing percentage	Weight of heart	Weight of lungs	Weight of liver	Weight of stomach and contents	Weight of intestines and contents	Weight of caul and mesenteric fat	Weight of total abdominal and thoracic viscera including fat	Width of fat back at fourth vertebra
			Pounds	*Pounds*	*Percent*	*Pound*	*Pounds*	*Pounds*	*Pounds*	*Pounds*	*Ponnds*	*Pounds*	*Inches*
I	Corn alone.....	28	120	92.0	76.67	0.6	1.5	2.5	3.75	9.50	2.10	19.95	1.75
		72	56	41.0	73.21	.3	.8	1.2	2.10	5.15	.85	10.40	1.25
		Ave.	88	66.5	75.57	.45	1.15	1.85	2.925	7.325	1.475	15.175	1.50
II	Corn, 9; tankage, 1....	32	168	129.5	77.08	.5	2.0	3.5	5.00	14.50	2.50	28.0	1.688
		73	161	125.0	77.64	.6	1.9	2.25	2.75	7.85	2.25	17.6	1.875
		Ave.	164.5	127.25	77.46	.55	1.95	2.875	3.875	11.175	2.375	22.8	1.781
III	Corn, 1; skimmilk, 1...	29	135	106.0	78.52	.5	1.75	2.5	2.5	9.25	1.35	17.85	1.875
		101	151	114.5	75.83	.6	1.75	2.75	3.5	12.80	2.30	23.70	1.750
		Ave.	143	110.25	77.20	.55	1.75	2.625	3.0	11.025	1.825	20.775	1.813
V	Corn, 1; skimmilk, 5...	105	170	133.5	78.53	.8	2.25	3.0	3.5	11.65	2.35	23.55	2.00
		52	195.5	154.0	78.77	.8	1.75	3.4	4.5	14.50	2.75	27.70	2.25
		Ave.	182.7	143.75	78.66	.8	2.00	3.2	4.0	13.075	2.55	25.625	2.125

SUMMARY

Experiment I.—While the results were not greatly different, slightly larger gains and a lower feed requirement per unit of gain resulted from feeding the tankage in a definite proportion to the corn, and in decreasing percentages in the ration, as compared with feeding it in a constant daily allowance by weight.

Experiment II.—Pigs fed a ration containing a smaller proportion of tankage each successive week made larger gains and required less feed per unit of gain than those fed a definite proportion of tankage or those fed a constant daily allowance. The last-named lot consumed less tankage and at the prices given made cheaper gains.

Experiment III.—The results of this experiment were in favor of feeding the tankage in a definite proportion to the corn rather than decreasing the proportion as the feeding period advanced. Unlike the results of Experiments I and II, the older pigs fed decreasing percentages of tankage in the ration gained at a lower rate and required more feed per unit of gain for the first two periods than those fed a constant percentage of tankage. Pigs weighing 75 pounds each at the beginning of the test were used.

Experiment IV.—Of the rations which contained the larger amounts of tankage, the rate of gain, the feed required to produce a pound of gain and the cost of gains were in favor of feeding the tankage in a definite proportion to the corn. With the rations containing a small amount of tankage, the results were in favor of feeding a larger percentage of tankage during the early part of the feeding period.

The two lots fed medium rations required less feed per unit of gain than the ones fed either the narrow or the wide rations.

Experiment V.—Pigs fed 10 percent of tankage in the ration ate more corn, gained in live weight 36.2 percent more rapidly and required 10.4 percent less total feed per unit of gain than pigs fed corn alone.

A ration containing 10 percent of tankage and 90 percent of corn resulted in a higher rate of gain and a lower feed requirement per unit of gain than one containing 20 percent or one containing 5 percent of tankage.

An increase in the percentage of supplemental feed in the ration increased the amount of supplement needed to replace a unit of corn.

Because of their higher content of nonnitrogenous nutrients, soybeans and linseed oilmeal, when fed on a basis of approximately equal amounts of protein, gave a higher feeding value per unit of protein than tankage.

For the first 8 weeks of the test the pigs fed a ration of corn, 5 parts; soybeans, 1 part, gained at a slightly lower rate, but consumed less feed per unit of gain than the pigs fed corn, 5 parts; linseed oilmeal, 1 part. For the last 4 weeks the latter ration produced gains at a much higher rate and with a lower feed requirement per unit of gain, even surpassing the ration containing 10 percent of tankage, which for the first 8 weeks of the test was superior to either.

Experiment VI.—In this experiment, in which 3-months-old pigs were used and allowed to choose for themselves the proportions of corn and supplement, a relatively large amount of tankage was consumed for the first 5 weeks of the test. During the remainder of the test a lower and fairly constant relative amount was consumed. The average for the experiment was 12.4 parts of corn to 1 part of tankage.

Experiment VII.—The ratio of milk to corn consumed by pigs fed both ad libitum decreased as the pigs became older.

Increasing the proportion of skimmilk in the ration decreased the supplemental or replacement value of a given weight of milk.

During the second half of the test there was less difference in favor of the rations containing skimmilk as compared with the one containing tankage than there was during the first half.

Experiment VIII.—When a ration of equal parts of corn and skimmilk was used in comparison with one of corn alone, 3.37 pounds of skimmilk replaced 1.37 pounds of corn for each pound of gain produced.

Rations of corn alone and of skimmilk alone gave poor results as compared with a ration of equal parts of corn and skimmilk. The skimmilk when fed alone had a much lower feeding value than when fed in combination with corn.

The pigs fed skimmilk alone made fair gains but did not fatten. Their average daily consumption of milk per head was 36.7 pounds. These pigs weighed 78.2 pounds per head when the experiment began and 196.1 pounds per head when it closed 105 days later.

In this test the pigs fed corn and tankage gained at a slightly higher rate than those fed corn and skimmilk in equal parts by weight. When skimmilk was used as a supplement, less total nutrients were needed to produce a unit of gain than when tankage was the supplement.

The higher dressing percentage of the pigs fed equal parts of corn and skimmilk would have given them a market value 4.7 percent higher than those fed corn alone and 6.7 percent higher than those fed skimmilk alone.

Experiment IX.—Pigs fed corn alone for 15 weeks made an average gain of 0.35 pound daily, with a feed requirement of 6.85 pounds per pound of gain. At the close of the experiment, after being accustomed to a corn-and-skimmilk ration, two representative pigs of the lot gained at the rate of 1.6 pounds daily for a period of 8 weeks.

The pigs fed corn and skimmilk, ad libitum, consumed an average of 6.4 pounds of milk per pound of corn. Their average consumption of milk was 20.5 pounds daily per pig. Their rate of gain was higher than that of the pigs fed less milk, and the amount of total nutrients required per pound of gain was lower. The ratio of milk to corn increased for the first 5 weeks of the test. From the seventh to the fifteenth week it gradually decreased.

An increase in the percentage of skimmilk in the ration decreased the supplemental or replacement value of a given weight of milk.

When rations (1) of corn and skimmilk, equal parts by weight, and (2) of corn, 9; tankage, 1, were fed in comparison with one of corn alone, less dry matter of the skimmilk than of the tankage was required to replace a unit of corn.

With the exception of the case in which the milk was fed with an equal weight of corn, the skimmilk decreased in feeding value as the pigs approached market maturity. The amount of decrease was directly proportional to the quantity of milk in the ration.

CONCLUSIONS

Further experiments are needed to determine the method by which a given amount of tankage should be proportioned. The results of the experiments reported were that, when the ration contained as much as 10 percent of tankage, there was no marked advantage in feeding a larger proportion of tankage in the early than in the later part of the test, and that, when as low as 5 percent of the ration consisted of tankage, it was advisable to feed a larger proportion during the early part of the experiment.

For dry-lot feeding of pigs 3 to 8 months old, an average of one part of tankage to from 9 to 13 parts of corn ordinarily produced larger gains with a lower feed requirement per unit of gain than rations containing larger or smaller percentages of tankage.

Skimmilk when fed in combination with corn has a much higher feeding value than when fed alone. There is strong evidence to indicate that as supplements to corn, skimmilk has a distinct advantage over tankage, particularly for young pigs.

There is no one feed that is always best to use as a supplement to corn, nor is there a definite proportion in which a given supplement should always be fed. The age of the pigs and the market prices of fat hogs, corn and supplements all need to be taken into account in determining what supplement to use and the proportion in which to use it.